PETROLEUM & NATURAL GAS IN INDIANA

BY

W. N. LOGAN, STATE GEOLOGIST

PUBLISHED BY
THE DEPARTMENT OF CONSERVATION
STATE OF INDIANA
DIVISION OF GEOLOGY
1920

THE

Department of Conservation

STATE OF INDIANA

W. A. GUTHRIE, Chairman.
STANLEY COULTER.
JOHN W. HOLTZMAN.
RICHARD M. HOLMAN, Secretary.

PUBLICATION No. 8

RICHARD LIEBER, Director.

THE DEPARTMENT OF CONSERVATION
DIVISION OF GEOLOGY

Petroleum and Natural Gas

IN INDIANA

A PRELIMINARY REPORT

By

W. N. LOGAN, Ph. D.
STATE GEOLOGIST

1920

FORT WAYNE PRINTING COMPANY
CONTRACTORS FOR INDIANA STATE PRINTING AND BINDING
FORT WAYNE, INDIANA
1920

GEOLOGICAL CORPS

W. N. Logan, Ph. D., State Geologist..........Economic Geology
E. R. Cummings, Ph. D..........Stratigraphy and Paleontology
C. A. Malott, Ph. D..........Topography and Glaciology
S. S. Visher, Ph. D..........Geography and Hydrology
J. R. Reeves..........Laboratory Assistant and Draftsman
H. W. Legge..........Preparator

Office Division

B. J. Malott, A. B..........Asst. Geologist and Supervisor Nat. Gas
A. J. Coleman..........Curator of Museum
Alice O'Connor..........Stenographer

Field Division, 1919

W. N. Logan
C. A. Malott
S. S. Visher
P. B. Stockdale
J. R. Reeves
O. H. Hughes
Willis Richardson
G. A. Lee
Fred. Call
Ted Jean

aC

PREFACE

The petroleum and natural gas industry of Indiana bears such an important relation to the industrial development of the State that any reasonable expenditure of funds is warranted in the furtherance of its development. Much of the field work necessary in the preparation of this report was accomplished with very little expense to the State as it was done in connection with other geological work by the University of Indiana, but it serves as an example of what may be accomplished whenever adequate funds are available.

The following report on the petroleum and natural gas resources of Indiana was prepared as a portion of a more comprehensive publication on the Geology of the State but the size of the report and the demand for the information contained in it combine to make it desirable to issue it as a separate publication and to give it a wider distribution than may be demanded of the complete report.

The undersigned deems it his duty to call attention to the scientific value of this publication. All credit must go to the author, Dr. Logan, and his staff, for painstaking thoroughness in its preparation with the idea of publishing all available authentic material on Indiana's oil and gas resources.

The great amount of work accomplished by the Division of Geology with limited funds is largely due to the plan of co-operation with Indiana university whereby the Division has the use of laboratory and library facilities which cannot be duplicated, if duplication be at all desirable, except at great cost, and also the assistance without additional expense of trained specialists in the various divisions of Geological Science. The University, by this co-operation is contributing invaluable assistance in working out the economic geology of Indiana.

RICHARD LIEBER,
Director of the Department of Conservation.

Indianapolis, January, 1920.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER I.

INTRODUCTION

No industry is more dependent upon science than is the petroleum industry upon the science of geology. The petroleum and natural gas industry of Indiana is of so much importance to the industrial development of the State that it should be given every aid which this science can supply for the solution of its problems. Enormous sums of money have been expended and are still being expended in Indiana in "wild-cat" drilling and the greater part of this form of prospecting is being indulged in without reference to the presence or absence of geological conditions favorable to the accumulation of oil and gas. Very naturally such prospecting leads to enormous losses and few gains.

In the absence of any comprehensive discussion of the subject of petroleum and natural gas in Indiana available for distribution and in response to hundreds of inquiries for information on the subject reaching the office of the Division of Geology, this report has been prepared.

The report is preliminary to the preparation of a more comprehensive report to be issued later. It was not possible in the limited time and with the limited funds at our disposal to make the report more complete. The collected information has not been studied as thoroughly as it should have been and hence conclusions have not been drawn where, perhaps, a more careful study of the evidence would warrant. However, since the industry is changing rapidly through development in parts of the State and decline in others no report can be prepared which will not need revision in a few years. In view of this fact it seems best to present such information as we have been able to bring together with the hope that it may be of immediate assistance to those who have so urgently requested it.

Those who are seeking petroleum in Indiana would do well to bear in mind that the geologist does not use "divining rod" or "witching" methods in the location of oil. He studies the structural conditions of the strata to determine whether such structural conditions are favorable to the accumulation of oil. For the determination of structural conditions he must be able to examine exposures of the bed rock or durolith, the indurated solid portion of the earth underlying the loose mantle of clay, sand, and gravel called the regolith.

In certain parts of Indiana the durolith is completely concealed by a thick covering of glacial drift and unless deep well records are available the geologist is without means of determining the structural conditions. The majority of the reported oil seeps from this part of the state are only oil-like films of oxide of iron on water seeping from glacial sands and gravels. Surface indications are of little value in oil prospecting in such a region. To be of value in any region they must be correctly interpreted.

In that portion of Indiana where the glacial covering is attenuated or in the non-glaciated portion the work of the geologist is not so hampered and wherever persistent hard layers of rock are present he is usually able to determine the structural conditions.

For the good of the petroleum industry in the future it is hoped that more money will be expended in securing favorable locations for wells and less expended on the drilling of wells that have been located without reference to the structural conditions. The money expended on one deep well will pay for securing the information and the publication of many thousands of copies of a report more comprehensive in its scope than the present one. Mistakes of location are expensive in more ways than one. Aside from the actual pecuniary loss in drilling the well, there is often a loss of confidence in the territory. For example, dry holes in sections one, two and three may condemn good territory in adjacent sections whereas if the structure had first been located the drilling of a single well on the structure might prove the territory.

It is important, therefore, that in all areas of the state where it is possible to determine the structural conditions this be done before any prospecting with the drill takes place.

The oil industry suffers from two classes of individuals, namely, from the purveyor of oil stock of the "blue sky" brand and from the activities of the fake oil expert. The laws of Indiana very wisely provide for the protection of its citizens against the dispenser of inferior foods. No one doubts that the abolition of the food inspection department would result in making the State the dumping ground for all sorts of foods of inferior quality. However, the average consumer of foods has some knowledge of their quality which knowledge is within itself a form of protection. But in the matter of oil stock, legislation affords inadequate protection and how many are qualified to judge of the value of oil stock?

Many States protect their citizens against the unscrupulous dealer in oil stocks. States without such protection naturally become the Meccas of jobbers in all sorts of oil stock of the "blue sky" brand. Some form of legislation is needed in Indiana to protect the novitious small investor from the machinations of the unscrupulous oil stock purveyor. Such legislation should not interfere with the legitimate attempts at the development of the oil industry in Indiana. It should not prevent the organization of local coöperative companies for the avowed purpose of developing prospective oil properties within the State. Nor should such companies be prevented under proper representations from offering the stock of such companies for sale. For in some parts of the State where it is impossible to determine the structural conditions and the only possible form of prospecting, that with the drill, is extremely hazardous, the expense of such testing should be widely distributed in order that the burden may not fall too heavily upon the few.

The purveyor of all oil stock should be required to furnish to the purchaser of such stock a sworn statement of the location of the oil property, the number of acres under lease, the state of development, and a certified copy of the report of the consulting geologist.

The oil operator, the investor in oil stock, and the general public need protection from the quack, the manipulator of the "divining rod", the witch hazel switch and other devices for the location of oil pools. Novitious oil companies are known to have used the funds secured from the sale of oil stock to small investors to drill a well costing as much as ten or twelve thousand dollars on a location made by the manipulator of a "divining rod".

The success of the competently trained geologist in the location of geological structures favorable to the accumulation of oil and gas has induced a large number of unprepared or illy prepared individuals to assume the role of oil geologists. Its rewards have also induced many pseudo-scientists to enter the field. Such impostors do not find employment with reputable oil companies of experience, but they gull the public through the mushroom companies of limited experience in the oil industry, and at the same time tend to bring discredit upon the science.

There are two ways of obtaining protection for the public against the activities of such impostors. One is to educate the people to an understanding of the scientific principles of oil geology, a very difficult task. A more immediate and effective method of protection might be secured through legislation which would provide for the licensing of oil experts by the State and measures prohibiting the practice of the profession of oil geologist by persons not possessing the requisite amount of training in the science and practice of geology.

ACKNOWLEDGEMENTS

The writer acknowledges his indebtedness to those who have written on the subject of petroleum and natural gas in Indiana. The information contained in the reports of Blatchley and others has been freely drawn upon in the preparation of the county reports. The publications mentioned in the accompanying bibliography have been especially helpful. The reference figures in the text apply to the numerals in this list of publications.

In the field work the writer has had the assistance of the members of the field party of 1919, the names of the members of which are given under Geological Corps.

Especial mention should be made of the assistance and advice of Dr. E. R. Cumings, the field work of Dr. C. A. Malott who, assisted by Mr. P. B. Stockdale, collected data for structural maps of portions of Jennings, Orange and Pike Counties, prepared a structural map of the Bloomington Quadrangle and assisted in other ways. Mr. O. H. Hughes, a member of the field party of 1917 and 1919, collected the data for a structural map of a portion of Jackson County. Dr. S. S. Visher collected data and prepared the report on Sullivan County. Mr. J. R. Reeves, a member of the field party for 1917 and 1919, prepared the maps and charts and assisted in other ways. Mr. B. J. Malott collected data, read manuscript and corrected proof. Miss Alice O'Connor did the stenographic work.

BIBLIOGRAPHY

1. "The Natural Gas Field of Indiana." Dr. A. J. Phinney, Eleventh Ann. Rept. U. S. G. S. Pt. 1, 1890, pp. 617-742.
2. "Natural Gas and Petroleum." S. S. Gorby, Sixteenth Ann. Rept. Indiana Dept. of Geology and Natural Resources, 1888, pp. 189-301.
3. "Petroleum Industry in Indiana." W. S. Blatchley, Ann. Indiana Dept. of Geology Reports, 1896, pp. 27-96; 1903, pp. 79-210; 1906, pp. 429-558.
4. "The Princeton Petroleum Field of Indiana." R. S. Blatchley, Ann. Rept. of Indiana, Dept. of Geol. 1906, pp. 559-607.
5. Special Report on Oil and Gas, E. Haworth, Uni. Geol. Sur. of Kansas, Vol. IX, 1908.
6. "Oil and Gas Resources of Kansas." Bul. 3, R. C. Moore and W. P. Haynes, State Geol. Survey of Kansas, 1917.
7. "Oil Geology," Dorsey Hager.
8. "Petroleum Technology," Bacon and Hamor.
9. "Oil," etc. Bul. 33, Ill. Geol. Survey, 1915, Kay and Savage.
10. "Petroleum and Natural Gas." Mineral Resources of U. S. for various years.
11. "Oil and Gas in Louisiana," G. D. Harris, Bul. 429, U. S. G. S. 1910.

CHAPTER II.

PETROLEUM: ITS PROPERTIES AND ORIGIN

Definition. Petroleum or crude oil is a mixture of gaseous, liquid and solid hydrocarbons in which the liquid elements predominate, but in which the percentage of each element is not a fixed quantity, but varies in different oils. The solid hydrocarbons are in solution and consist of paraffin or asphaltum or in some oils of both. Those oils with asphaltum in solution are said to have an asphalt base and those containing paraffin to have a paraffin base. The paraffin oils predominate east of the Mississippi River and the asphalt oils west.

Composition. The chemical compounds of which petroleum is a mechanical mixture belong to a number of hydrocarbon series. They include the marsh gas series, C_nH_{2n+2}, ranging from CH_4 to $C_{35}H_{72}$. The first member is gaseous, the middle members liquid, and the last members are solid paraffins. The olefiant series, C_nH_{2n}, is represented by some of its members in small amounts. The Acetylene series, C_nH_{2n-2}, is represented in some petroleums. The fourth series is C_nH_{2n-4}. The fifth or benzine series, C_nH_{2n-6}, is represented in nearly all petroleums.

The elementary analyses of various petroleums indicate that the per cent of carbon varies from 83.5 to 86.6; the per cent of hydrogen from 12 to 14.8, and the per cent of oxygen from 0.1 to 6.9. These three elements make up the larger part of the oil, but nitrogen and sulphur occur in minute quantities usually.

Color. The color of petroleum varies with the sand or field. Pennsylvanian oils have a greenish color; the Kansas-Oklahoma oils have a yellowish tint; California oils are black; Indiana oils greenish black; some Kentucky oils are green by reflected light and red by transmitted light.

Odor. The odor of most petroleums is slight, but some oils have an odor resembling some of their products such as gasolene or kerosene.

Density. The specific gravity of petroleum varies from 0.77 in some light oils to 1 in the heavier oils. The average for the American petroleums is about 0.89. The oil from the Lima-Indiana field ranges in specific gravity from 0.816 to 0.86. The Terre Haute oil has a specific gravity of 0.879; the Jasper oil of 0.928.

Boiling Point. The temperature of boiling ranges from 180° F. in Pennsylvanian oils to 338° F. in some German oils. The point of solidification ranges from 82° F. to several degrees below zero.

The Flashing Point. The flashing point of petroleum varies from zero in some Italian oils to 338° F. in some African oils. The fuel value of the oil from the eastern Indiana field is 18,900 B. T. U.

Specific Gravity. The specific gravity of a substance is its weight compared with the same volume of water which is assumed to have a specific gravity of 1. Petroleum usually floats on water and has a specific

gravity less than that of water. The specific gravity of petroleum may be expressed as a decimal fraction, as .8588, or the Baumé scale may be used for oils lighter than water, in which case it will be expressed in degrees. If the oil has a specific gravity equal to water its specific gravity as expressed on the Baumé scale is 10°.

In the determination of specific gravity of oils the hydrometer is used. This instrument consists of a glass column provided with the Baumé scale graduated in degrees from 10 to 100 and an expanded portion below the scale which contains mercury to sink the hydrometer to the point which registers its specific gravity if the temperature of the fluid is 60° F. For lower or higher temperatures, corrections must be made. The specific gravity may be calculated by adding 130 to the reading on the hydrometer and dividing 140 by the sum, as $\frac{140}{40+130} = .8235$ specific gravity.

The following table will show the relation between the Baumé scale and specific gravity and weight per gallon:

Degrees Baume.	Specific Gravity.	Pounds per Gallon	Degrees Baumé	Specific Gravity	Pounds per Gallon	Degrees Baumé	Specific Gravity	Pounds per Gallon
10	1.0000	8.33	32	.8641	7.20	54	.7608	8.34
11	.9929	8.27	33	.8588	7.15	55	.7567	6.30
12	.9859	8.21	34	.8536	7.11	56	.7526	6.27
13	.9790	8.16	35	.8484	7.07	57	.7486	6.24
14	.9722	8.10	26	.9433	7.03	58	.7446	6.20
15	.9655	8.04	37	.8383	6.98	59	.7407	6.17
16	.9589	7.99	38	.8333	6.94	60	.7368	6.14
17	.9523	7.93	39	.8284	6.90	61	.7329	6.11
18	.9459	7.88	40	.8235	6.86	62	.7290	6.07
19	.9395	7.83	41	.8187	6.82	63	.7253	6.04
20	.9333	7.78	42	.8139	6.78	64	.7216	6.01
21	.9271	7.72	43	.8092	6.74	65	.7179	5.98
22	.9210	7.67	44	.8045	6.70	66	.7142	5.95
23	.9150	7.62	45	.8000	6.66	67	.7106	5.92
24	.9090	7.57	46	.7954	6.63	68	.7070	5.89
25	.9032	7.53	47	.7909	6.59	69	.7035	5.86
26	.8974	7.48	48	.7865	6.55	70	.7000	5.83
27	.8917	7.43	49	.7821	6.52	71	.6829	5.69
28	.8860	7.38	50	.7777	6.48	72	.6666	5.55
29	.8805	7.34	51	.7734	6.44	73	.6511	5.42
30	.8750	7.29	52	.7692	6.41	74	.6363	5.30
31	.8695	7.24	53	.7650	6.37	75	.6222	5.18

Petroleum Products. The various products obtained from crude petroleum are kerosene, gasolene, benzene, naphtha, rhigolene, vaseline, paraffin, lubricating oil, petroleum butter, formolit, asphalt, oil coke, gas carbon, special illuminating oils such as mineral sperm and astral oil.

Origin of Petroleum and Natural Gas.

The close association of petroleum and natural gas points to a common origin. The hydrocarbons which form them are identical or closely related. The gases given off by petroleum are similar to those of natural gas, which may be converted into liquid by increase of pressure at low temperature, as may be the gas given off by petroleum. Natural gas is commonly present in petroleum, and they often exist together, though natural gas may exist alone.

The theories of the origin of oil and gas fall into two classes: the inorganic and the organic.

Inorganic Theories. A chemical theory was suggested by Humbolt and further elaborated by Berthelot[1] and Mendeleeff[2]. This theory assumes that the interior of the earth contains metallic iron and carbides of iron; that the high interior heat of the earth converts water into steam, which attacks the carbides of iron, producing hydrocarbons which are forced toward the surface by the expanding power of steam. According to this theory the hydrocarbons formed should be predominately of the acetylene series, but they are predominately of the methane series; they should be associated with igneous rather than sedimentary rocks.

Another inorganic theory is the volcanic theory of Costé[3] which assumes that oil and gas are the result of volcanic action. Costé asserts that animal remains are not intombed in the rocks and that vegetable remains decompose into carbonaceous matter and further distillation of carbonaceous matter has not taken place in nature; that gaseous, liquid, and solid hydrocarbons are the result of volcanic activity, because oil and gas are under great pressure which must be volcanic; heated oil and gas exists in some fields; oil and gas occur in folded and fissured regions parallel with great orogenic movements; oil and gas and bitumens are never indigenous to the strata in which they are found and that the density of rocks precludes the possibility of anything except volcanic pressure forcing oil and gas through them. Many of these assertions do not accord with the observed facts. The almost complete restriction of oil and gas to sedimentary rocks placed at great distance from volcanic activity and the decrease in pressure in wells are not in harmony with this theory.

Organic Theory. This theory assumes that oil and gas have been generated from animal and vegetable matter by a slow process of distillation. Many accumulated geological facts may be enumerated in support of this theory, such as: The close association of rocks containing organic matter to those containing oil and gas; drops of oil have been found in decaying plant remains; natural gas, a constituent of both oil and gas, is generated from vegetable matter buried in porous beds; it is present in coal as are other hydrocarbons of petroleum; such gases as carbon dioxide, hydrogen, marsh gas and nitrogen are formed during the decay of sea weeds. Hydrocarbons analgous to those in natural gas, petroleum and asphalt have been derived from either plant or animal remains. Natural petroleum has optical properties similar to those of organic compounds which inorganically synthesized oil does not possess.

The presence of oil in shales from which as much as twenty-five gallons per ton have been extracted has strengthened the belief that the organic matter of shales is the source of petroleum. It is assumed that the bituminous matter is the form of a solid, organic gum, kerogen, which may be converted into liquid hydrocarbons by the application of heat. McCoy[1] placed an oil shale under pressure and secured liquid hydrocarbons from it and asserts that liquid hydrocarbons can be formed from solid bituminous material at ordinary temperatures and under pressures of

[1]Berthelot, E. M. P. Annales Chem. Phys., Vol. I, 1866, p. 481.
[2]Mendeleeff, D. Der Deutch. Chem. Gesell, 1877, p. 229.
[3]Costé, E. Am. Inst. Min. Eng., Vol. XX, p. 504. 1914.

5,000 to 6,000 pounds, such as exist at the depth of oil bearing horizons; and that the only place where such compounds would be formed are in areas of differential movement.

Kemp has recently called attention to the presence of asphaltum in the beach sands of Florida and the possibility of the origin of petroleum from the marine and terrestrial organisms in buried coastal sands.

The optical behavior of petroleum under polarized light is said to be due to the presence of cholesterol, which may be derived from animal fats and phytosterol, which is also a constituent of vegetable oils, facts strongly supporting the organic theory of the origin of petroleum. In fact, the weight of evidence at the present time seems to favor the organic theory. The remains of land plants and animals may have contributed in a minor way to the accumulations of petroleum, but marine organisms were probably the greater contributors of the original compounds from which the petroleum was extracted through long periods of time at possibly only ordinary rock pressures and at moderately low temperatures.

OIL WELLS IN INDIANA

COUNTIES	1906-1910 Completed	1906-1910 Dry	1910-1914 Completed	1910-1914 Dry	Wells Abandoned 1915
Adams	112	13	20	1	866
Blackford	158	28	22	5	1389
Cass	3	2	......	......	....
Daviess	2	0	10	2	....
Delaware	297	75	125	28	1320
Dubois	5	4	5	1	....
Gibson	96	28	30	2	5
Grant	480	42	11	2	4141
Hamilton	......	......	0	0	....
Harrison	......	......	2	0	....
Huntington	206	9	0	0	891
Jay	561	112	100	17	554
Knox	4	3	19	17	12
Madison	11	3	3	3	87
Marion	......	......	0	0	15
Martin	2	1	2	1	....
Miami	1	1	3	3	49
Pike	280	63	116	25	3
Pulaski	4	3	......	......	....
Randolph	59	18	33	0	213
Shelby	......	......	4	0	....
Sullivan	3	3	758	271	1
Vigo	3	2	7	2	....
Wabash	......	......	1	0	16
Warrick	3	3	1	1	....
Wells	497	71	35	2	3950
Miscellaneous	128	91	30	15	....

[1]McCoy, Alex. W. Journal of Geol., Vol. XXVII, 4 p. 252.
[2]Kemp, J. F. Econ. Geol., Vol. XIV, 4 p. 302.

PETROLEUM PRODUCTION IN INDIANA

Date	Barrels	Value
1889	33,375	$ 31,414
1890	63,496	55,403
1891	136,634	91,545
1892	698,068	388,300
1893	2,335,293	1,494,588
1894	3,688,666	2,654,840
1895	4,386,132	4,780,884
1896	4,680,732	2,954,411
1897	4,122,356	1,880,412
1898	3,730,907	2,214,322
1899	3,848,182	3,363,738
1900	4,874,392	4,693,983
1901	5,757,086	4,822,826
1902	7,880,896	6,526,622
1903	9,186,411	10,474,127
1904	11,339,124	12,235,574
1905	10,964,247	9,404,909
1906	7,673,477	6,770,066
1907	5,128,037	4,536,930
1908	3,283,629	3,203,883
1909	2,296,086	1,997,610
1910	2,159,725	1,568,475
1911	1,695,289	1,228,835
1912	970,009	885,975
1913	956,095	1,279,226
1914	1,335,456	1,548,042
1915	875,758	813,365
1916	769,036	1,207,565
1917	759,432	1,470,548
1918		

(Compiled from Mineral Resources of the United States.)

CHAPTER III.

NATURAL GAS

Definition: Natural gas is a mixture of hydrocarbons (chiefly) which are gaseous at ordinary atmospheric temperatures. The principal hydrocarbon is marsh gas (CH_4), methane or fire damp. Natural gas also contains small quantities of ethane (C_2H_4), Olefine (C_2H_6), Carbon dioxide (CO_2), Carbon monoxide (CO), Oxygen (O), Nitrogen (N), Hydrogen (H), Helium (He), Neon (Ne) and Hydrogen sulphide (H_2S). However, not all natural gases contain all of these gases.

Physical Properties. Natural gas is colorless and usually odorless, though the presence of such gases as hydrogen sulphide may produce a perceptible odor. It is usually inflammable though some natural gases contain so much nitrogen as to be non-combustible. It burns with a luminous flame and deposits carbon when the flame is brought in contact with objects of lower temperature. It readily mixes with air and forms an explosive mixture.

Gas Pressure. Natural gas as it occurs in the earth is usually under pressure which ranges as high as 2,000 pounds per square inch. This pressure is commonly called "rock pressure" and decreases as the gas becomes exhausted. The pressure is probably due to the expansive force of the confined gas.

Chemical Properties. The maximum amount of the various constituents found in natural gas is: Marsh gas, 98.40%; Ethane, 14.60%; Olifinant, .39%; Carbon dioxide, 1.6%; Carbon monoxide (CO), 2.5%; Oxygen (O), 3.46%; Nitrogen (N), 85.83%; Hydrogen (H), 11.51%; Helium (He), 1.84%; and Hydrogen sulphide (H_2S), .20%.

The composition of natural gases from various fields is given below for comparison with the analysis of a gas from Muncie:

COMPOSITION OF NATURAL GASES

State.	Methane (C H_4)	Ethane (C_2H_6)	Olefine (C_2 H_4)	Carbon Dioxide (CO_2)	Carbon Monoxide (CO)	Cxigen	Nitrogen	Hydrogen	Helium	Hydrogen Sulphide (H_2 S)	Location.
Indiana.........	92.67	......	.25	.25	.45	.35	2.53	2.35	......	.15	Muncie.
Illinois..........	73.81	......	......	.81	......	3.46	21.92	......	......	......	Pittsfield.
Ohio............	92.61	......	.30	.26	.50	.34	3.61	2.18	......	.20	Findlay.
Kansas..........	94.40	......	......	......	......	.23	5.08	......	.183	......	Iola.
Kansas..........	14.85	.41	......	......	......	.20	82.70	tr.	1.84	......	Dexter.

Origin of Natural Gas. Since natural gas is closely associated with petroleum they are thought to have a common origin. They often occur together, though one may occur without the presence of the other. Nearly all petroleums contain at least small quantities of natural gas. Since natural gas is free to move independent of the movement of water it may accumulate in a different reservoir though having a common origin with petroleum. For instance, it may accumulate, in fact does accumulate, in glacial sands and gravels at a horizon far from its point of origin.

The principal constituent of most natural gases is marsh gas (CH_4). This gas also accumulates in marshes where decaying organic matter is surrounded with porous sands. This gas is also found in coal beds and is one of the constituents of petroleum. These facts argue for an organic origin for natural gas and for a common origin with petroleum.

PRODUCTION OF NATURAL GAS IN INDIANA

Year	No. Producers	Value	Wells, Gas	Wells, Dry	Productive Wells
1886	....	$300,000	(Est. Amt.	Coal Displaced)	
1887	....	600,000	" "	" "	
1888	....	1,320,000	" "	" "	
1889	....	2,075,702	" "	" "	
1890	93	2,302,500	....	......	435
1891	93	3,942,500	....	......	305
1892	159	4,716,000	....	......	570
1893	....	5,718,000	....	......	....
1894	....	5,437,000	....	......	....
1895	....	5,203,200	....	......	....
1896	....	5,043,635	....	......	....
1897	452	5,009,208	419	66	2,881
1898	533	5,060,969	706	111	3,325
1899	571	6,680,370	838	109	3,909
1900	670	7,254,539	861	156	4,546
1901	656	6,954,566	985	208	4,572
1902	929	7,081,344	1,331	205	5,820
1903	924	6,098,364	895	242	5,514
1904	846	4,342,409	706	153	4,684
1905	740	3,094,134	252	74	3,650
1906	578	1,750,715	159	46	3,523
1907	687	1,572,605	185	56	3,386
1908	823	1,312,507	187	41	3,223
1909	1,010	1,616,903	190	70	2,938
1910	1,027	1,473,403	69	33	2,955
1911	1,094	1,192,418	110	32	2,744
1912	1,140	1,014,295	96	39	2,547
1913	1,100	843,047	69	24	2,370
1914	1,029	755,407	68	19	2,224
1915	999	695,380	65	11	2,063
1916	995	503,373	43	14	1,967
1917	941	453,000	42	17	1,830

(Compiled from Mineral Resources of the United States)

NATURAL GAS IN INDIANA

			Pressure in Lbs.		
COUNTIES	Depth of Well		1910		1914
Adams	1,000-1,050		100	(1912)	-6
Bartholomew	864- 990		50-250		80-150
Blackford	850-1,100		1- 10		0- 20
Clark	128- 244		27	(1912)	......
Daviess					25- 40
Martin	300- 600		0- 60		......
Decatur	700-1,200		0-315		5-350
Delaware	728-1,500		0- 70		0- 60
Franklin	728- 730		60	(1913)	......
Grant	830-1,200		2- 50		0- 50
Hamilton	800-1,280		15-180		0-230
Hancock	700-1,100		0-100		6- 80
Harrison	320- 764	(1911)	60-110		0. 50
Henry	800-1,200		0- 90		4-100
Howard	800-1,100		0-220		30-160
Jay	900-1,600		0- 40		0- 40
Jefferson	1,360		10	(1911)	20
Madison	800-1,200		0-190		0-100
Miami	900-1,000		0- 40		......
Marion					
Ripley	880-1,050		40		70-300
Pike	1,000-1,400		125-500		50-225
Randolph	900-1,300		0-180		1-125
Rush	700-1,400		20-325		15-325
Shelby	650-1,020		1-375		20-300
Spencer	1,025		410	(1912)	
Sullivan	698- 795		200		50-185
Tipton	750-1,100		10-230		3-100
Wayne	800-1,150		50-240		45

GAS DEPLETION

An examination of the pressure of gas in the wells of Indiana shows that the gas is being rapidly depleted. The pressure recorded in some of the wells in 1910 was 250 pounds per square inch and in 1914 the same wells showed a pressure of only 150 pounds.

The following methods of computing gas depletion are given by the Treasury Department of the United States[1]:

"**Details of production or the performance record of the well or property.**—As a general rule the demand on a natural gas property is a variable factor. In certain fields, however, the demand from some wells has from the beginning, or for considerable periods, been greater than the supply, so that the amount of gas marketed per well may, as in the case of oil, show a regular decline, which will be indicative of the total amount that the well may be expected to produce, and also the rate of production. Even where the demand does not greatly exceed the supply, the amount and

[1]Manual for the Oil and Gas Industry, U. S. Treasury Dept., 1919.

rate of past production may in certain cases throw light on the future of the well or property.

"**Decline in open-flow capacity.**—Where data are available the decline in open-flow capacity indicates in a general way the rate of exhaustion of the gas field. The relationship is not at all close and varies from field to field and from well to well. Also for most gas wells accurate data on decline in open-flow capacity are not available. Nevertheless it is probable that for certain properties this method will have value, for with rare exceptions the production of gas from a well leads to a decline in its capacity, and the fraction produced is roughly proportional to the decline.

"**Comparison with life history of similar wells or properties, particularly those now exhausted or nearing exhaustion.**—Where no other data are available the rate of depletion of a gas well or property may be approximated by comparison with a neighboring well or property that has reached a later stage in life. Particularly is this applicable in a district where many gas wells have become exhausted. For example, in a region where wells produce from 8 to 12 years, or an average of 10 years, a 10 per cent deduction will be a rough approximation of depletion.

"**Size of reservoir and pressure of gas, or the pore-space method.** For some properties the pore-space method may be best for estimating underground supplies of natural gas and for a good many it will furnish additional evidence of value. The method would be ideal if the average percentage of pore-space, the extent and thickness of the sand, and the pressure of the gas could be accurately ascertained. In computing the reserves of an individual property by this method the migratory character of gas must be considered and the production and behavior of adjacent properties taken into account. The factors that make the method difficult to apply are difficulty of accurately ascertaining the thickness of pay, limits of pool, percentage of pore-space, the effect of encroaching water and oil, and the quantity of gas remaining when commercial production is no longer possible.

"Take, for example, a pool where there is no encroachment by water. Suppose that the pore-space is 25 per cent, the thickness of the pay 20 feet, and the extent of the pool 10 square miles, or roughly 280,000,000 square feet. The volume of the reservoir would be 1,400,000,000 cubic feet, and the amount of gas in the sand could be readily computed by taking into account the closed pressure of the wells.

"**Other indications of depletion.**—Additional evidence of decreasing supply of natural gas in the ground is commonly observable in the behavior of the wells and the provision that must be made for transporting the gas to market. Observations on minute pressure show more or less progressive change as the wells become older and an increasing amount of gas is drawn from the ground. Line pressures and pressures at compressing stations are also likely to show a progressive change in the same direction. The appearance of water or oil in a gas well or in neighboring gas wells may be a very significant symptom of the approaching termination of the life of the well. The clogging of gas wells by paraffin, salt, or other deposits may demand modification of depletion estimates.

Closed-Pressure Method

"Because of its general applicability, the closed-pressure method is by far the best method of estimating the depletion of gas properties.

"Unfortunately, accurate closed-pressure data have not been kept for all properties or perhaps even for the majority of properties, but the rock pressure in most pools is known or is ascertained with a fair degree of accuracy, and the information drawn from the pressure decline is, with the exception of a few fields, not subject to profound modification, because of factors whose value can not be appraised. The basis of this method is Boyle's law. According to this law of physics, if gas is pumped into a vessel until the pressure is 200 pounds and then is drawn off until the pressure is 100 pounds, the size of the vessel remaining fixed, and ignoring for the moment atmospheric pressure, it may be concluded that one-half of the gas has been drawn out of the vessel. If an underground gas reservoir of fixed dimensions is tapped by wells and the pressure is found to be a thousand pounds, and then if the gas is drawn off through the wells until the gas pressure in the pool is lowered to 100 pounds, we may infer that about nine-tenths of the supply of gas has been exhausted.

"**'Unit Cost' as applied to natural gas.**—Although, as a rule, the number of cubic feet of gas under a tract cannot be satisfactorily estimated and the quantity that will be marketed is even less definite, the "unit cost method" can be used by regarding pounds of closed pressure as units, for the actual quantity of gas underground commonly varies with the decline in pressure and the relative quantity at the beginning and end of the tax year and at the time of abandonment, is, in the lack of better information, usable for tax purposes.

"**Corrections and refinements of closed-pressure method.**—Several corrections and more or less important refinements are made in applying this method to the computation of depletion, and it should be borne in mind that it does not afford data on the amount of gas originally in the pool or at any later specified time, but only the fraction of the gas that has been removed from its natural reservoir does not remain fixed but becomes smaller as the gas is drawn and water or oil advances into a part of the space formerly occupied by the gas. The pressure is thus prevented from declining at a rate proportionate to the amount of gas drawn from the pool. The correction on account of water or oil encroachment is difficult to make, because of the lack of data to determine the extent of the encroachment. However, in a good many pools, after a study of the distribution of wells that have been "drowned out" and the history of water troubles in similar nearby pools, it is possible to make allowance for water or oil encroachment which will more or less closely approximate the facts.

"Another refinement applicable to the computation of depletion of natural gas by the closed-pressure method is based upon the fact that even where there is no encroachment of water or oil the depletion is not precisely represented by the gauge readings, though the errors are generally so small that they may be ignored. For example, where the pressure declines from 1,000 to 500 pounds, the gas is not exactly half gone, for the reason the pressures referred to are gauge readings and to each should be

added the pressure of the atmosphere—for most fields about 14.4 pounds to the square inch. The fraction remaining in the ground then becomes $\frac{514.4.}{1014.4}$

"Account should also be taken of the pressure at which wells are abandoned in the field or district.

"If wells can not be operated with profit after the pressure has declined to 25 pounds gauge reading (39.4 pounds absolute), then the percentage of recoverable gas remaining when the pressure has declined from 1,000 to 500 pounds gauge reading is not one-half or even the fraction $\frac{514.4}{1014.4}$ but $\frac{475.}{975.}$ The difference in the fraction where pressures of several hundred pounds are involved is not great and scarcely worth considering in view of the other errors which are certain to affect the result. However, after the pressure has declined to a low figure, the matter of correcting the fraction becomes of considerable importance. Thus, if the pressure of abandonment is 4 pounds gauge reading and during the year the average closed pressure of a pool has declined from 10 pounds to 5 pounds gauge reading, five-sixths instead of one-half of the recoverable gas has been withdrawn.

"Still another refinement that has, as a rule, more theoretical than practical value may be worthy of consideration in certain instances. This arises out of the fact that gases do not expand precisely as the pressure decreases, and that even if the size of the natural reservoir remains fixed the pressure does not decline in exact proportion to the amount of gas removed. The difference amounts to only a few per cent and is greatest for high pressure. In the decline from 1,000 to 500 pounds per square inch the gas expands several per cent more than would be calculated by a strict application of the law and in a decline from 1,500 pounds to 1,000 pounds the departure is still greater. The correction varies from field to field because of the different constitution of the gases, though since most natural gases consist largely of methane the variations on account of differences in gases are not great.

"A fourth detail of refinement arises out of the fact that on the average more gas is marketed for 50 pounds of decline in pressure after the pressure has reached 100 pounds or less than an equal decline while the pressure is high, as, for example, 1,000 pounds per square inch. Also the expense of marketing gas after the pressure has become low is greater than when it was high, largely because of the necessity of installing compressors to push the gas through the pipe lines to the consumers. These two considerations have a tendency to balance each other and, with certain exceptions, will not be of sufficient importance to warrant to apply the corrections.

Method of Gauging

"In using the closed-pressure method of estimating depletion, the method of gauging is of vital importance and in many fields is not carried out with sufficient care. Care should be taken to make sure that the gauge is accurate, testing it before and after attaching it to the well. If it must be

transported far or is subject to much jolting in transportation, a gauge tester should be taken along and used at the well.

"Care should also be taken to empty the well of oil and water by pumping, blowing or siphoning before attaching the gauge, for any liquid in the hole will lower the closed pressure reading.

"The well should be closed long enough to allow pressure to build up to its maximum. The length of time necessary for this purpose varies a great deal from field to field and well to well. The well should remain closed until the pressure will not build up more than 1 per cent in 10 minutes. Ordinarily, 24 hours will be sufficient for this purpose, but for some wells several days or even a longer period will be required, owing to the slowness of equalization of pressure in the sand."

CHAPTER IV

MODE OF ACCUMULATION

Experience in oil fields has taught that oil may accumulate under certain conditions in either synclines or anticlines. In the absence of water in synclines oil may move downward under the influence of gravitation to the bottom of the syncline. (See Fig. 4.) Of course it is not known whether the oil has migrated downward from the limbs of the syncline or the roof of the porous layer or been moved upward by capillarity to the bottom of the syncline from underlying beds of oil bearing shales, though it is doubtful that the latter would produce sufficient concentration. The essential conditions for oil accumulations are: First, a source of the oil

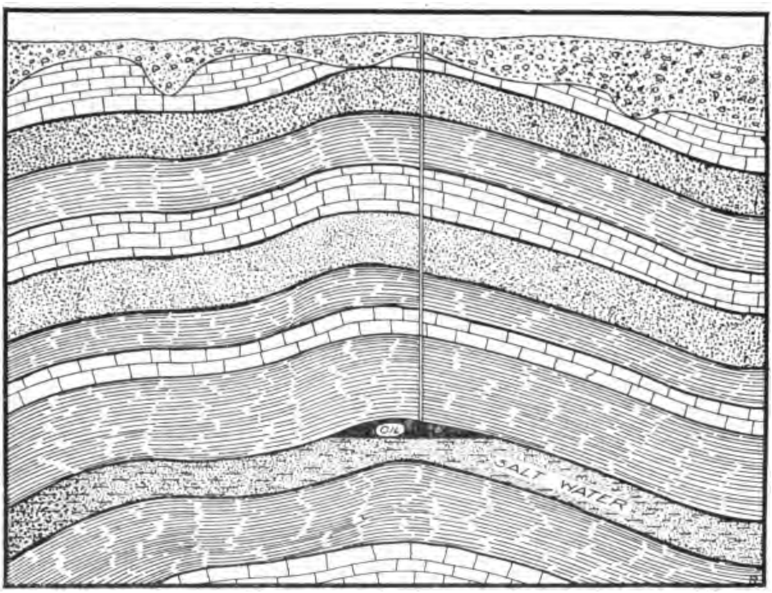

Fig. 2. A diagramatic cross section of an anticline showing the mode of occurrence of oil when no gas is present.

which may be a bituminous rock probably at no great distance from the point of accumulation. Second, a porous bed of rock which acts as a reservoir. This porous bed must be contained between impervious layers of rock. Third, the presence of flextures in the reservoir. In the absence of water in the reservoir the oil will collect in the downward folds (synclines), but if water is present no oil collects in the synclines but only in the anticlinal or upward folds as the oil advances to the highest point

occupied by the water which would be in the upper part of the anticline. From this point it would be impossible for the oil to advance as its progress is checked by the impervious roof layer which dips down below the level occupied by the oil.

Relation of Geological Structure to Oil and Gas Accumulation. Oil and gas are widely distributed in the rocks of the earth as is evident from their presence in rocks, in mines, in seeps, the water of springs and deep wells. But accumulations of oil and gas of economic importance are far less widely distributed since special geological conditions are necessary to the concentration of oil and gas in economic quantities. Oil and gas generated in some bituminous beds, rise under the agencies of migration and reach a porous bed as widely distributed particles, and are therefore, valueless, from an economic standpoint. The concentration of oil and gas

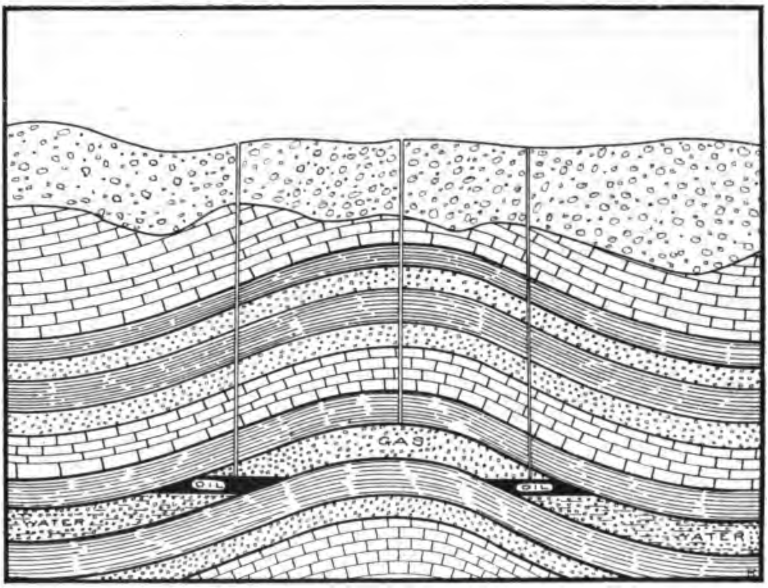

Fig. 3. A diagramatic cross section of an anticline, the most abundant type of oil bearing structure. In this anticline water, oil and gas are present arranged in the order of their specific gravities. The removal of the gas will permit the oil and water to rise higher toward the apex of the structure.

can be brought about if certain geological structures are present in the porous bed containing the oil and the gas. The presence or absence of such concentrating structures may, in most cases, be determined by the geologist so that a knowledge of geology is fundamental to the development of the oil industry.

Oil Sands. The rock in which the oil and gas accumulates is commonly termed the "oil sand" though it is often not a true sand but a porous rock

such as limestone. More commonly the oil accumulates in a porous sand, sandstone, or conglomerate, less commonly in porous limestone and very rarely in fissures in shales or in the cavities in igneous rocks. The quantity of oil possible in an oil sand will depend upon the degree of porosity of the sand which in turn depends upon the size and arrangement of the sand grains in the case of a true sand and on the size of the cavities in the case of a porous limestone. The pore space in compacted but uncemented sands ranges as high as 25 per cent, in sandstones to 15 per cent and in conglomerates to as high as 32 per cent. The amount of pore-space produced by the size and the arrangement of the grains may be reduced by deposition of cement in the pores.

Geological Structures Favorable to the Accumulation of Oil. There are certain structural conditions which are favorable to the accumulation of oil and gas. Such conditions may exist without the presence of oil or gas,

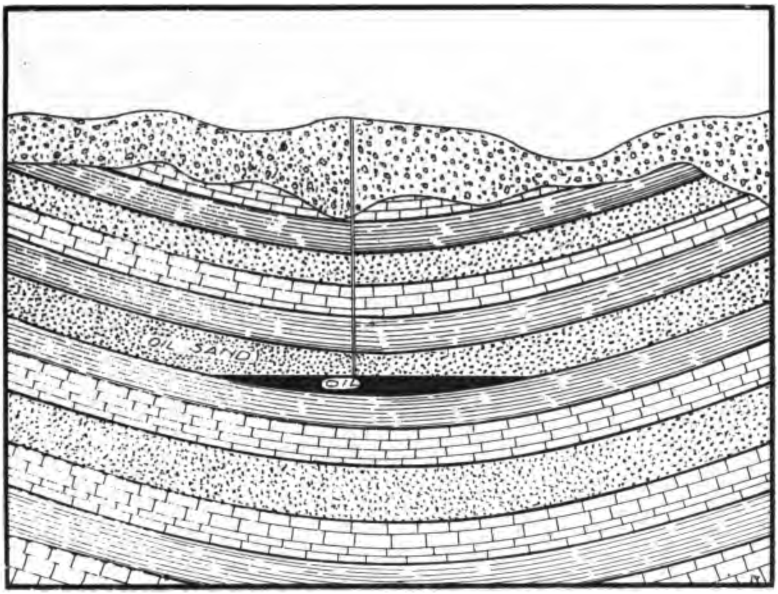

Fig. 4. A diagram to show possible mode of accumulation of oil in a syncline. The sand is a dry sand, that is it does not contain any water. Since the oil is free to move under the action of gravity it will sink to the lowest portion of the porous layer.

but so far as is known, accumulations of oil or gas do not occur without the presence of such favorable structural conditions. Among the more favorable structures for the accumulation of oil and gas are: The anticline, monocline, structural terrace, dome, fault, joints, lenses, igneous intrusions, and synclines.

The Anticline. The anticline is an upward bend or fold in the rock strata which forms a trap which prevents the escape of the oil or gas

when they have once penetrated it. The essential conditions for the accumulation of petroleum in an anticline is the presence in the fold of a porous layer of rock enclosed between two layers of impervious rock. For example, a layer of porous sandstone between two layers of shale. The presence of water in the porous layer is also essential. If no gas is present, the oil will accumulate in the highest portion of the porous layer. (See figure 2.) The oil being of lighter specific gravity collects in the upper part of the porous layer above the water. If gas be present, the three will arrange themselves in order of their specific gravities. (See figure 3.) The pressure of the gas in this case forces the oil and the water to the limbs of the anticline. With the escape of the gas the oil and the water would tend to rise in the porous layer and arrange themselves in order of their specific gravities.

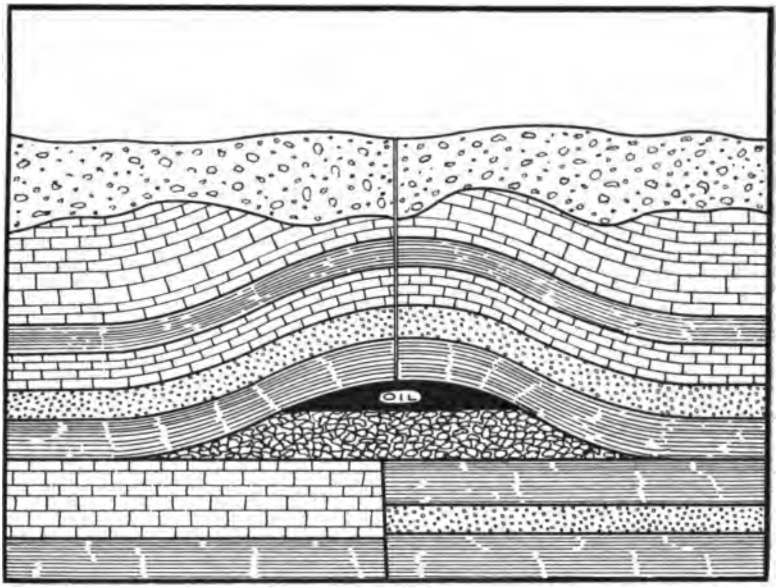

Fig. 5. A diagramatic cross section of a salt dome structure favorable to the accumulation of oil. Soluble salts carried by ascending solutions are deposited under strata which are forced upward forming a dome. Oil passing upward along the fault plane accumulates in the porous deposit formed by the salts.

Syncline. The presence of oil in downward folds of rocks called synclines, occurs under certain conditions. (See figure 4.) If no water is present in the porous layer, the oil under the influence of gravitation may be carried down to the bottom of the syncline and there remain, held in by impervious layers of rock above and below. Oil is obtained from synclines in Pennsylvania and Ohio. No oil has been obtained from such structures in Indiana. No dry oil reservoirs have been found as yet.

The Dome. The dome or salt dome is an anticlinal structure produced by accumulation of minerals under strata along the plane of a subsurface or a sealed fault. (See figure 5). Such structures are common in the Gulf Coastal Plain in the states of Louisiana and Texas. According to Harris[1] these domes are produced by water carrying minerals such as salt, gypsum, lime carbonate and magnesium carbonate in solution ascending along a fault plane to a point beneath the surface where the minerals were deposited through the evaporation of the water. The accumulation of the mineral matter elevates the super-incumbent beds and the oil accumulates in porous beds of limestone or in sands overlying or tilted up against the salt core. Topographically these domes may form conspicuous mounds on the flat prairies of the coast. Continual erosion of

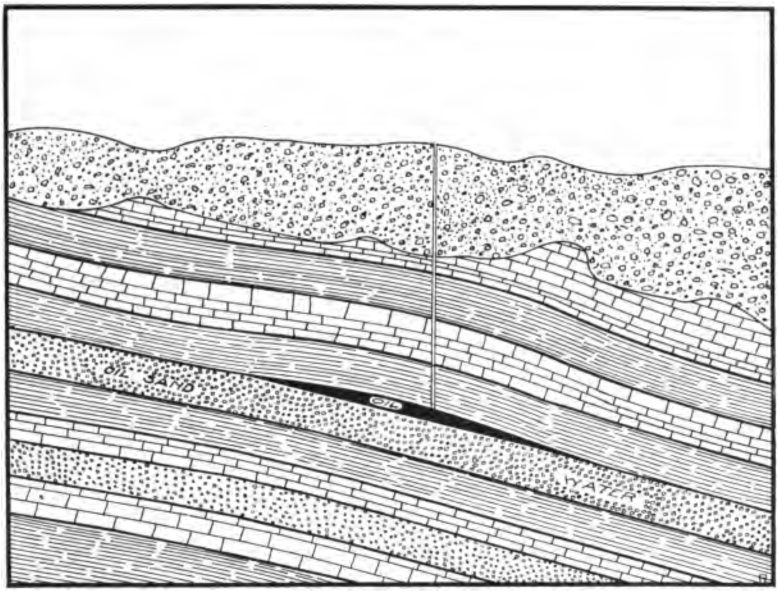

Fig. 6. A diagramatic cross section of a monocline showing a possible mode of oil accumulation. A slight irregularity in the direction of dip in the shale layer above the oil sand produces a condition which is favorable to the accumulation of oil. This irregularity may or may not express itself at the surface.

the surface of the mound as the salt accumulates may bring deep seated beds of rock 900 feet or more nearer the surface than their normal position for that area. Numerous faults are produced by the doming and the oil and gas pass to the porous beds along these faults. A number of domes may be distributed along a major fault.

The Monocline. Rock strata are often inclined in only one direction and form a monocline. That is they may pass from one horizontal posi-

[1]Harris, G. D. Bul. La. Geol. Sur. No. 7, 1908 p. 75 et seq.

tion to another horizontal position or from one inclined position to another inclined position without reversing the direction of dip of the strata. Under certain conditions monoclines afford favorable conditions for the accumulation of oil. (See figure 6.) The inclination of the beds is here greatly exaggerated and gives the impression of reversal of dip. Lenses of sand or sandstone enclosed in shales in monoclines furnish favorable conditions for oil concentration.

The Structural Terrace. The structural terrace may be called a flattened monocline. The strata which are inclined pass to a horizontal position or from a greater to less degree of inclination and then back to the same

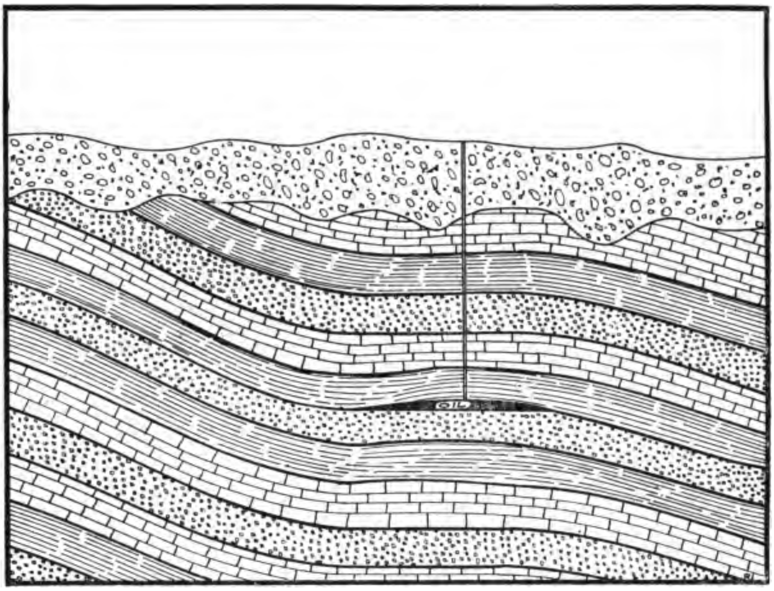

Fig. 7. A diagramatic cross section of a structural terrace. Showing possible mode of accumulation of oil in the flattened portion of the structure when water is present in the oil bearing stratum.

degree of inclination first assumed. (See figure 7.) In the horizontal portion the trap is formed and the oil accumulates if water be present in the porous layer. The structural terrace occurs in the Mississippian area of Indiana in probably more than one locality. There is one at least in Orange County and one in Martin County. Noses and shoulders which are modifications of the terrace occur in Jackson and Jennings Counties. In the latter one has produced some gas, though the drilling was not done in the most favorable spot and was done without reference to the structure.

Lens Structure. Lenses of porus sand or sandstones inclosed in bituminous shales may afford conditions favorable to the accumulation of oil and gas. (See figure 8.) The lenses may lie in a horizontal position or

be inclined and still furnish the proper conditions for accumulation. Since such structures do not express themselves in any way at the surface and prospecting with the drill is the only method of determining the presence, size, or shape of the structures, the geologist can locate the position and probable extent of the enclosing shale bed, but cannot indicate the position of the lenses. Sandstones or sands with convex upper surfaces due to unconformable relation with overlying beds or to lenticular shape; or standstones with higher porosity in some parts than in others furnish adequate conditions for oil and gas accumulation when they are confined in impervious layers of rock. It is probable that such conditions exist in the Mississippian and Pennsylvanian strata of southwestern Indiana and that they are responsible for some of the oil and gas accumulations.

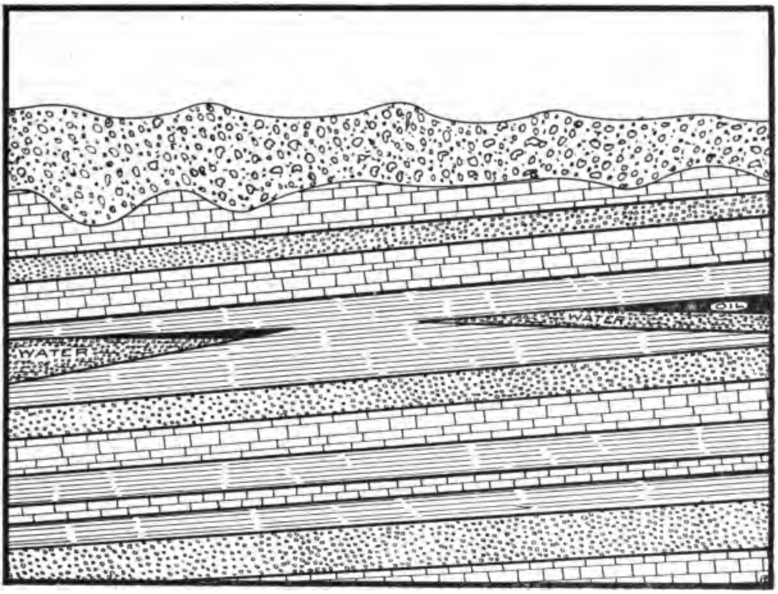

Fig. 8. A diagram showing a possible mode of accumulation of oil in lenses of sand enclosed in beds of shale. Such a structure may exist in the southwestern oil field in Indiana.

Fault Structure. The occurrence of oil in connection with sealed faults is an established fact. The oil migrates upward along the fault plane until it reaches a porous bed so situated as to form a trap. (Figure 9.) Beds of bituminous shale and beds of standstone may be displaced in such a way as to throw shale bed against shale bed, thus sealing the fault. If a porous bed lying between impervious beds is faulted, in such a way as to form a trap, the accumulation of oil may result. In the case of a fault cutting a rising oil and gas bearing sand the fault may seal the sand in such a way as to prevent the upward movement of the oil and the gas and cause it to accumulate. The fault is sealed by bringing the broken

end of the sand layer against a shale layer. Since prospecting is more hazardous in connection with faults than anticlinal folds, little testing of the former has taken place. Structures of this type may occur in connection with the Mount Carmel fault in Indiana, but no tests have been made to determine whether they exist and are productive. There is little doubt that the fault is sealed because Knobstone shale has been faulted against Knobstone shale and sandstone layers are confined below.

Joints. Oil has been known to accumulate in joints under certain conditions. The conditions are such that the joint virtually acts as the porous layer and must occupy a position between impervious layers and be so situated as to form a trap. (Figure 10.) The joint layer of rock in this case forms the reservoir. Such rocks are necessarily hard rocks, unyielding under pressure, and not exposed to the agents of cementation. Oil is found in joint cracks in some fields in California and in Colorado. Structures of this type are not known to occur in Indiana.

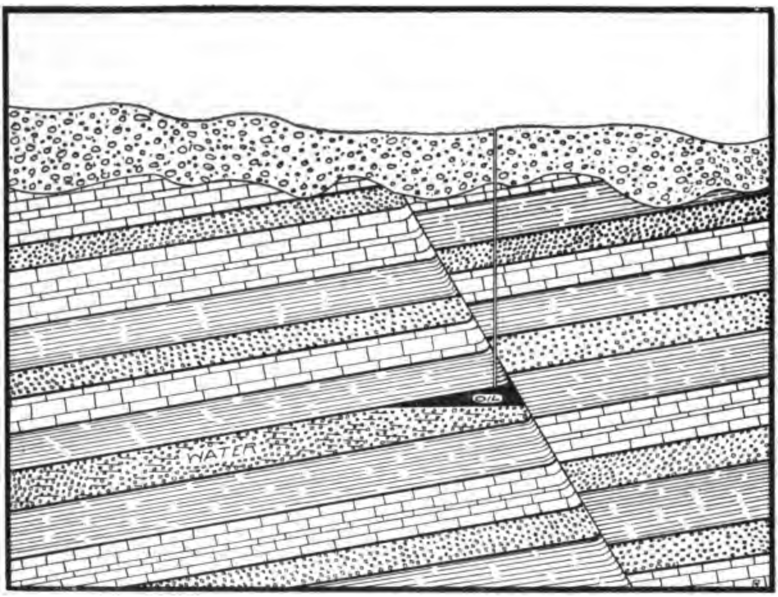

Fig. 9. A diagram to show the mode of accumulation of oil on the upthrow side of a fault. A porous layer has been faulted against an impervious layer of shale in such a way as to seal the fault and produce a collecting ground for the oil near the fault line.

Igneous Intrusions.[1] The vertical or nearly vertical intrusion of igneous rocks into sedimentary strata which contain beds of bituminous rocks may result in the accumulation of oil near the intrusion. (Figure 11.) The injection of the igneous rock causes an upturning of the sedimentary beds on the sides of the igneous core. The sealing of the end of the upturned

[1]Clapp, Econ. Geol. VII, 1912, 364.

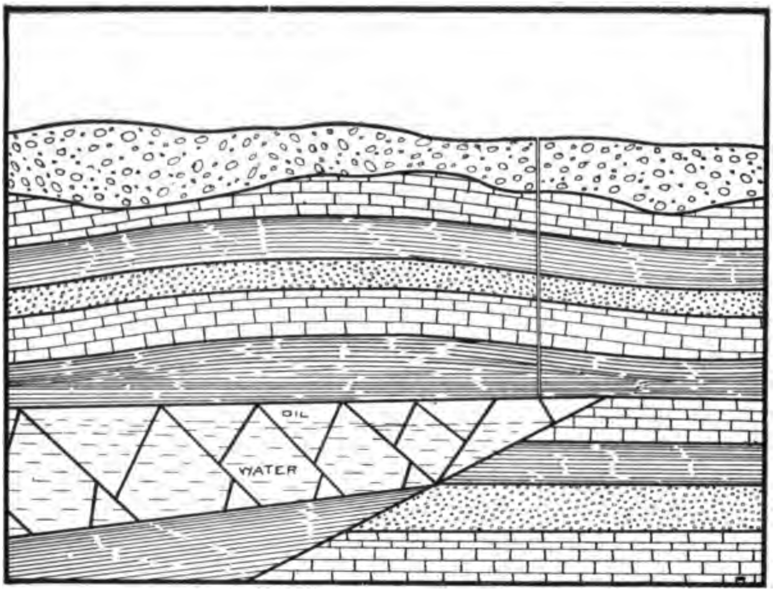

Fig. 10. A diagram to show possible method of accumulation of oil in the joints of rocks. This type of structure is not common.

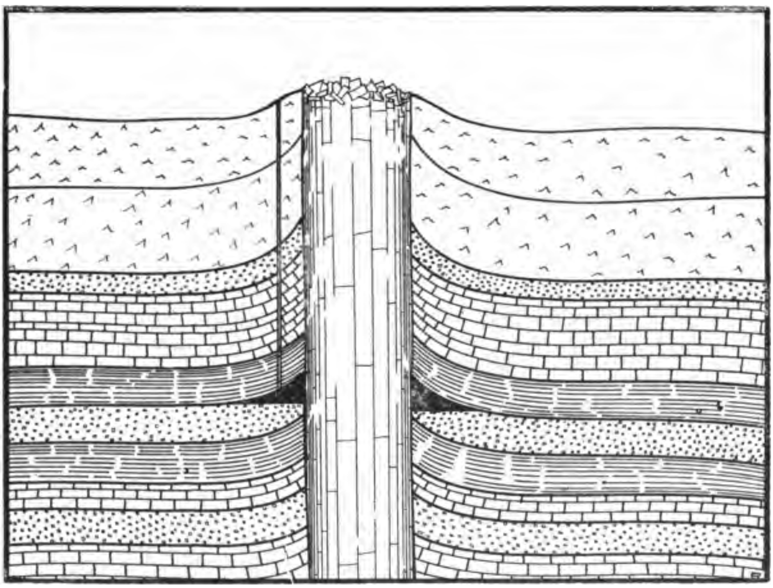

Fig. 11. A diagram to show possible accumulation of oil in a structure produced by an igneous intrusion. The oil sand in this case may be either of sedimentary or igneous origin. The igneous rock may be either primarily porous like cellular basalt or it may receive its porosity by alteration subsequent to its intrusion.

oil and gas reservoir provides conditions favorable to the accumulation of oil and gas.

The sealing may be done by the igneous rock or by hydrothermal action of the porous bed, rendering it impervious. Oil seeps may reach the surface from the oil pools along fault planes produced during the upward bending of the beds. Structures of this type do not occur in Indiana as vulcanism has not expressed itself in the State.

The geological structures favorable to the accumulation of oil and gas which may be encountered in Indiana are anticlinal, monoclinal, terrace, fault and lens structures. Oil bearing synclines are not likely to be present because of the abundance of water in the porous beds of rock. The other types of occurrence are associated with special conditions which do not exist in Indiana.

CHAPTER V.

PROSPECTING FOR OIL AND GAS

The best equipment that an oil prospector can have is a thorough training in the science of Geology. He must have a knowledge of the geological conditions of the field in which he is prospecting. This must include a knowledge of the nature of the rocks, not merely at the surface but to a considerable depth. This information he may obtain from surface outcrops, railroad cuts, stream courses, excavations, well records and geological reports.

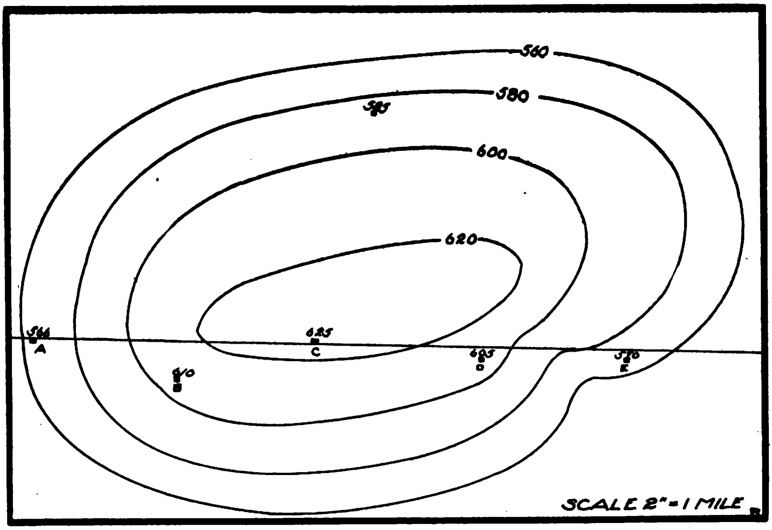

Fig. 12. Diagram of an anticline represented by contours drawn on the surface of a bed of coal. Contour interval twenty feet. Position of the bed of coal determined by well records.

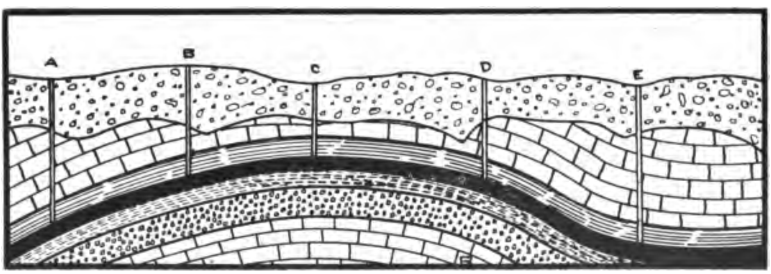

Fig. 13. A cross section of the above anticline along the line A. B. C. D.E.

He will need to have a knowledge of the age of the rocks since the occurrence of oil and gas in the oldest rocks of the earth has not been recorded. He will need to know that oil and gas are not found in igneous and metamorphic rocks, but are confined to sedimentary rocks. He will need to know further that certain kinds of sedimentary rocks are not likely to contain oil and gas. He will learn to look with favor upon rocks containing organic matter or rocks associated with rocks containing organic matter, evidence of which will be found in fossils, lignite, and prevailing dark colors. He will look with disfavor upon rocks with prevailing red or yellow color, because the oxidized condition of the iron compounds points to the absence of organic matter.

A knowledge of the structure of the rocks is essential because of its bearing on the accumulation of oil and gas. They accumulate in beds of porous rocks. If the rocks are dry the oil will accumulate in the lower part of the porous bed and the gas in the upper part, if water is present they will be arranged in the order of their specific gravities, with the gas at the top and the water at the bottom. It is obvious that if the porous rock were of uniform thickness and horizontal in position that there would be no concentration of oil and gas. At best there would be only a film of oil on the water. In other words, there must be irregularities of certain kinds either in the bedding or in the structure which will permit the concentration of the oil and gas at one point. And so the prospector must be able to recognize such structures as anticlines, monoclines, synclines, terraces, and faults.

If the anticline is small it may be determined frequently by direct observation. If the anticline is broad, or the degree of inclination is slight, other means of determination must be used. In some instances the structure may be determined by locating upon the map the strike and the dip of the strata. The succession of the rocks should be carefully determined then a layer of relatively hard rock which is continuous over a large area should be selected and the strike and the dip of this bed at many points be recorded on a map. By this means reverse dips will be indicated and the nature of the structure determined.

The determination of the structure is often more difficult because of the slight degree of dip or because it may be difficult to find a layer that is continuous over large areas and which may be relied upon as a key formation. In regions where the structure is sufficiently pronounced and where there are established elevations (bench marks) for comparison, the aneroid barometer may be used and the structure be worked upon the key rock. The key rock may be a bed of coal, (figure 12) or a layer of any persistent rock such as limestone or sandstone. The elevations of the key rock above sea level should be determined for the various parts of the area, and upon a map representing this area, the points of equal elevation should be joined. By drawing lines through points of equal elevation for each ten or twenty feet of difference in elevation, the shape and the size of the structure may be exhibited. The elevations of the key rock may be determined at its outcrops by using a plane table and a telescopic alidade and stadia. In the absence of bench marks, they may be set by using plane table and stadia. The outcrops may then be located with aneroid barometer by checking frequently on the established bench marks.

Exploitation. The development of the oil and gas industry began with the drilling of the first well by Colonel Drake, on Oil Creek in Pennsylvania in 1859. Great progress has been made since that date in both methods and machinery. Haphazard methods by untrained men in small companies having little capital have given way to scientific methods practiced by trained experts in power companies of large capital. No industry responds more readily to careful scientific methods than the oil and gas industry, for this reason the wise company employes trained men in each

Fig. 14. Standard derricks. (Ill. Geol. Survey).

of the various departments which are a necessary part of the industry. In the absence of a sufficient number of trained engineers some large companies have established apprenticeships for inexperienced men and paid them wages while training them for their positions. In the development of new oil territory much preliminary work must be done before the drilling can be begun.

Locating the Structure. The first work in the new field falls to the Geologist. He is required to locate and to carefully map the geological structure. No wise company starts drilling operations until it has assurance that the geological conditions are favorable for the accumulation of oil. This assurance can only be given by some one thoroughly trained in the science of geology. There are pseudo-geologists, so-called practical

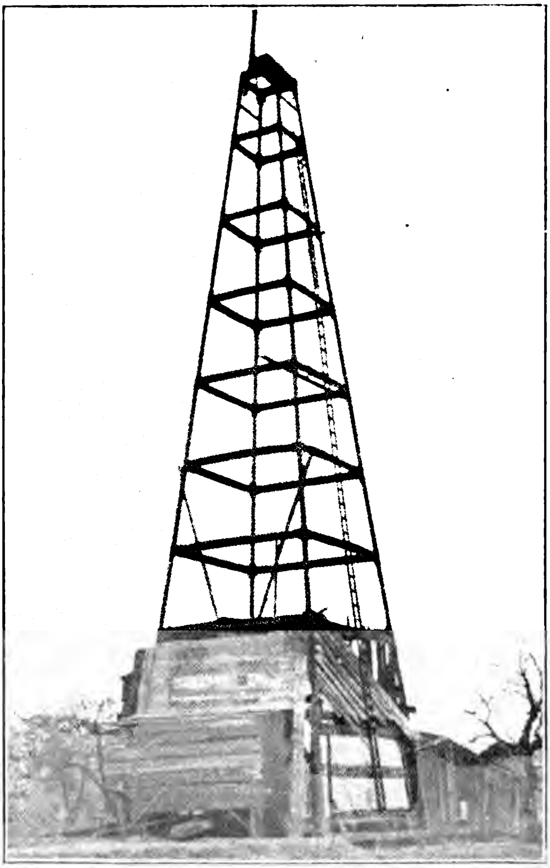

Fig. 15. A steel framed derrick. (Photo by Ill. Survey).

geologists, who can lay small claim to any real knowledge of the science and such men have done much harm to the industry as well as discredit to the science. But so strongly intrenched has the science of geology become in the oil industry that some large companies keep in their employ more than one hundred geologists many of whom have attained high rank in the profession.

Securing Leases. After an oil company has determined the location of favorable geologic structure, leases covering the area are secured as rapidly as possible. The leases are in the nature of written agreements between the owner of the land and the oil company. The terms of such agreements vary greatly in different states and even in different parts of the same state. The lease gives a description of the land covered by the lease, duration of the lease, and states the compensation to be received by the lessor. The property is usually described by the quarter section, town and range. The time of the duration of the lease may be from one to five years with the option of extending the lease to cover the period of produc-

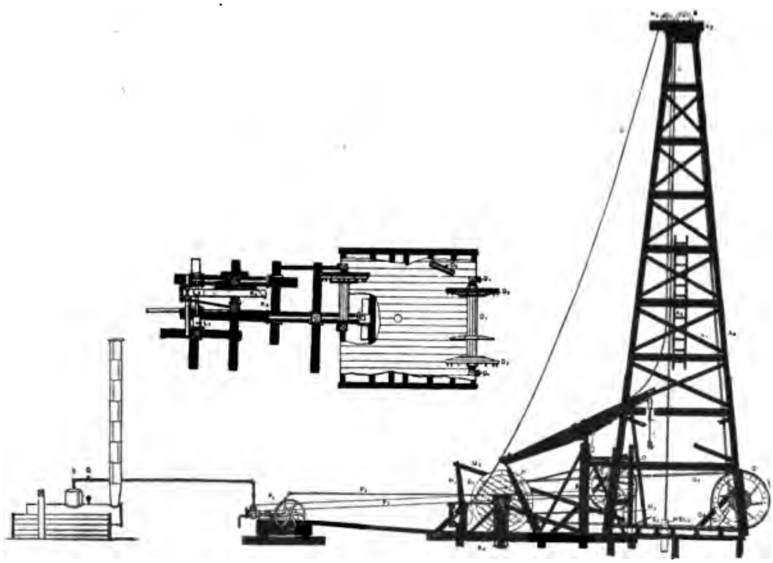

Fig. 16. Standard drilling outfit, coupled for raising tools. (After Bowman, U. S. Geol. Survey.)

A Derrick foundation posts.
A^2 Mudsills.
A^3 Subsill.
A^4 Main sill.
A^5 Derrick legs.
A^6 Derrick girts.
A^7 Derrick braces
A^8 Ladder.
A^9 Crown block.
B Crown pulley.
C^1 Drilling Cable.
D Bull-wheel shaft.
D^2, D^3 Bull wheels.
D^4 Bull-wheel posts.
D^5 Bull-wheel post brace.
D^6 Bull rope.
D^7 Bull-wheel brake band.
E^1 Calf-wheel.
E^2 Calf-wheel brake lever.
F Sampson post
G Walking beam.
H Pitman.
J Temper screw.
K^1 Band Wheel.
K^2 Tug pulley.
K^4 Band-wheel crank.
L^1 Sand-reel drum.
L^2 Sand-reel pulley.
M^1 Sand-reel lever.
M^2 Sand-reel reach.
M^3 Sand-reel handle.
N^1 Sand-pump line.
N^2 Sand-pump pulley.
O Calf-wheel posts.
P^1 Throttle-valve wheel.
P^2 Telegraph cord and throttle valve.
P^3 Rod to reverse engine.
Q Globe valve.

tion. The lessor is paid one dollar to make the agreement legally binding. His further compensation may take the form of a fixed rental per acre such as one-fourth of one dollar per acre annually in wild cat territory to many hundreds of dollars in proven territory. The compensation may take the form of a royalty of one-twelfth, one-eighth, or one-sixth of the production. In exceptional good territory an additional bonus of $100 to $300 per acre may be paid.

By the terms of some leases rentals do not begin until after the drilling of the first well which must occur before the expiration of a certain period, say two years. In leases providing for cash yearly rentals no provision is made for the completion of a well; it generally being considered to the advantage of the operator to prove his territory as soon as possible so as to avoid payment of unproductive rentals. Some leases provide for the time of beginning and finishing the first well.

The terms of the lease provide that the lessee shall have access to the land and the use of enough of the surface of the land for the establishing of his equipment and for conducting operations necessary to production. The lessor has the use of all land not necessary to the operations of the lessee. In the event of natural gas instead of oil being found on the property under lease, the owner of the property is protected by a clause in the lease which provides for the payment for the gas based on the number of cubic feet produced. Some leases provide for the payment of from $100 to $150 per year per well to the land holder and free gas for his use.

Locating the Wells. The location of the wells on the structure is a matter of considerable importance. The location of the first well should be chosen with care since a failure tends to condemn the entire structure. When gas and oil are present in an anticlinal structure, as gas, oil and water arrange themselves in the order of their specific gravities, gas may be expected in the highest portion of the porous stratum, oil farther down the dip and water still farther down the structure.

Locations along the crest or apex of the anticline may, under such circumstances yield gas and if oil is desired a location should be made farther down the dip. If gas is not present, oil may occupy the highest part of the porous layer and rest beneath the surface of the apex of the structure.

If the first well is productive, the second well is located near the first following the supposed trend of the structure. The distance between the wells should be governed by the thickness and the porosity of the oil sand. If the oil sand is thin and porous, the wells may be placed further apart, say 1,000 to 1,500 feet. If the oil sand is thick and not very porous, the wells may be placed 500 feet apart or even less. Some operators place one well to every ten acres. In the drilling of deep wells much money is wasted by close placing of wells.

Drilling Methods. Methods of drilling oil wells and the type of drill used varies with the depth of the wells, the character of the rocks penetrated, and other conditions. For moderately shallow wells in soft strata the portable type of drill may be used. (See figure 18.) Such rigs are easily transported over rough roads and rapidly put down to depths not exceeding 1,200 feet, but wells have been put down to depths of 2,500 feet by the use of such rigs.

The rig most in use for the drilling of deep wells is known as the "Standard" which consists of a derrick, with walking beam, bull wheel, cable with tools attached, and other accessories. (Figure 14.) The derrick may be either a steel frame (Figure 15) or wood, but consists of four uprights converging toward the top and tied and braced at intervals with cross pieces. The height of the derrick is usually 70 or more feet, about 20 feet wide at the bottom and four feet at the top. The bottom of the

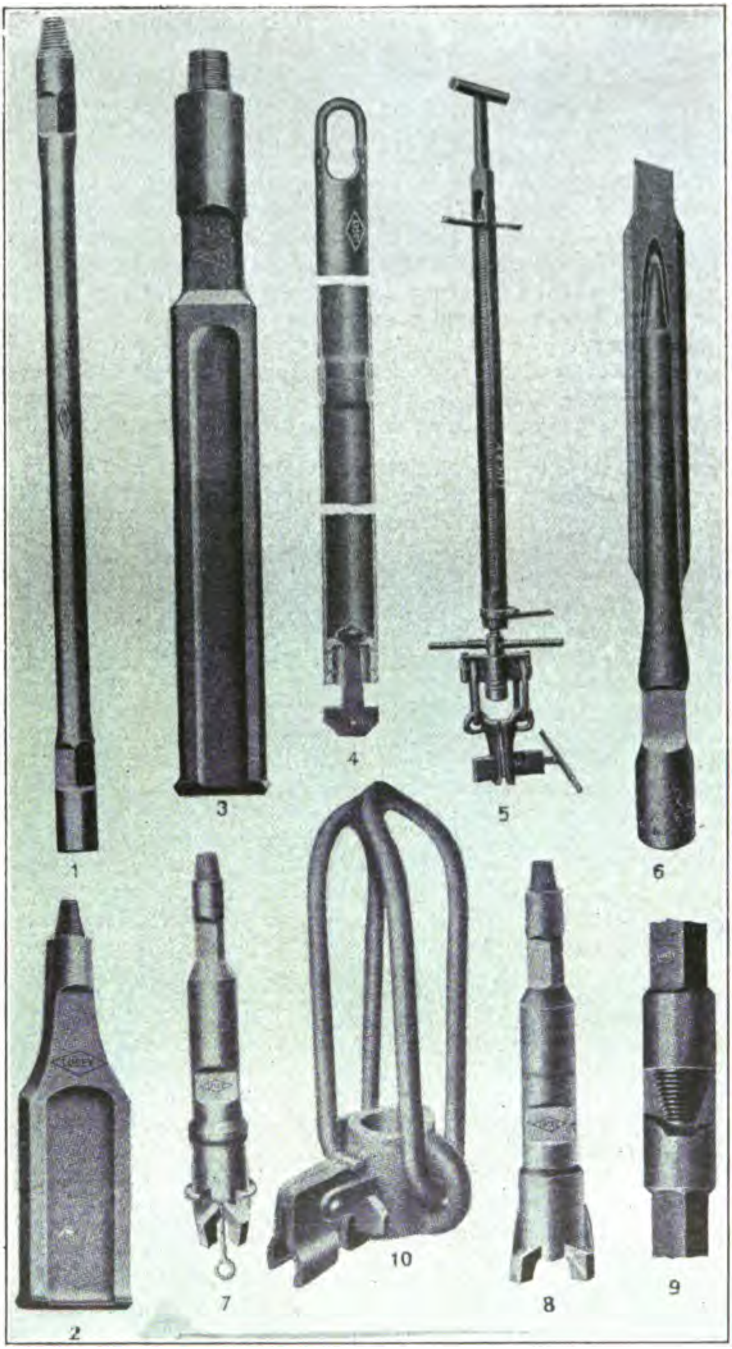

Fig. 17. Drilling tools. 1. Augur stem; 2, spudding bit; 3, drilling bit; 4, bailer; 5, temper screw; 6, drilling jars; 7-8, underreamer, closed and open; 9, joint; 10, elevator, for lifting casing into derrick. (Lucey.)

derrick rests upon large beams, rocks, or concrete and supports at the top, the crown block bearing the pulleys for the cables attached to the drill and sand pump.

The cable, composed of manilla or wire is wound upon the shaft of the bull wheel, while one end passes over the crown pulley at the top of the derrick and down to the end of the walking beam, to which the temper screw is attached by one end, the other end is clamped to the cable. (Figure 16.) To the end of the cable is attached the string of tools which consists of the rope socket, sinker bar, jars, auger stem, and auger. (Figure 17.) The walking beam is pivoted at the middle to an upright post and is attached by a pitman rod to a crank on the band wheel. The motion of the band wheel moves the walking beam up and down alternately lifting and dropping the auger and string of tools in the bore. As the bore is deepened the temper screw (Figure 18) is turned until the bore has increased in depth a full screw length, about five feet, when the temper screw is unclamped from the cable, the latter is wound on the bull wheel shaft and the tools are lifted from the well. The well is then bailed by lowering a sand pump or a bailer into the well by a line passing over the sand-reel pulley, allowing it to fill and elevating it to the surface by the same line. The bailer consists of a cylindrical body of galvanized iron with a bail at the top and a stem valve at the bottom. When the stem rests on the bottom of the bore it raises the valve and allows the bailer to fill, but when lifted from the bottom the valve drops into place and the water and drillings are carried to the surface and allowed to escape as the stem of the valve rests on the bottom of the water trough.

An engine and boiler are necessary to furnish power to the drill, the engine being connected to the band wheel by a belt. The fuel used for the boiler may be coal, oil or gas. Water for the boiler may be supplied from wells, springs, streams, or ponds.

Drive Pipe and Casing. Whenever a well is started in loose rock such as glacial drift or forms of mantle rock, a large iron pipe called drive pipe is forced through the mantle rock, following the drill and set on the solid bed rock. This pipe prevents caving of the soft strata and keeps water out of the drill hole. If, during the process of drilling, a porous layer is encountered, containing water under pressure, it may be necessary to lower the string of casing inside the drive pipe and set it on an impervious layer below the water bearing layer in order to shut out the water. If other water bearing layers are encountered, other strings of casings must be lowered. In deep wells it is often necessary to have eight or ten different sizes of casings, starting with an 18-inch casing and ending with a 2-inch.

Cost of Oil Wells. The cost of an oil well varies with a number of factors, such as depth, character of rock, accessability to fuel, transportation conditions and others. The cost of work preliminary to the actual drilling is the same regardless of the depth of the well, providing the same type of rig is used for both shallow and deep wells. The cost of actual drilling per foot increases with the depth. The light portable rig which may be used to advantage in Indiana in drilling wells ranging up to 1,200

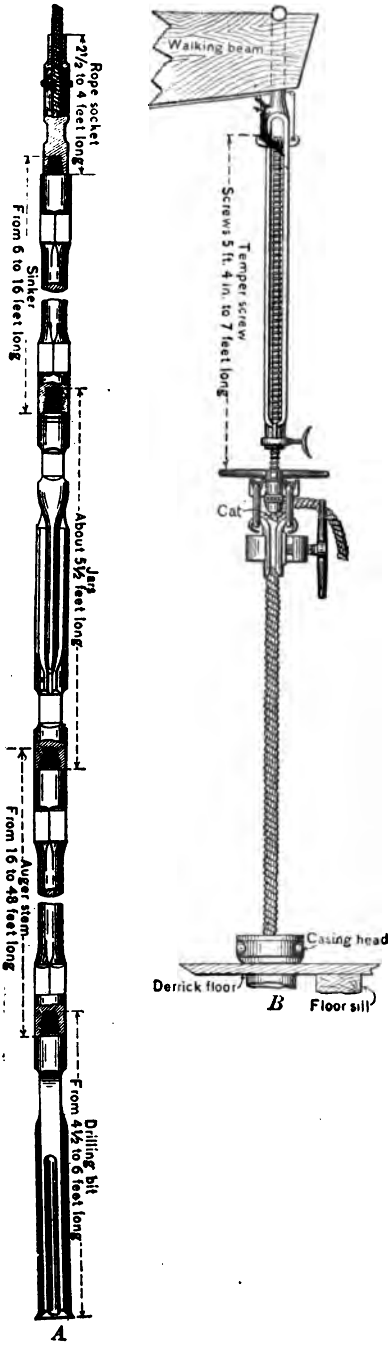

Fig. 18. A, String of tools used with standard drilling outfit; B, temper screw. (After Bowman, U. S. G. S.)

or 1,500 feet in depth and has been used in wells as deep as 2,400 feet, cost \$2,500 to \$3,000. The Standard rigs because of the construction of the derrick, cost much more. The cost of wells having depths ranging from 800 to 1,000 feet is from \$2,000 to \$2,500. Wells of twice those depths, cost from \$6,000 to \$8,000. Drillers usually contract to drill a well to a certain depth at so much per foot for the drilling and installing the casing, which is to be furnished by the owner of the well. The cost of casing varies from \$1 per foot for the smaller sizes to \$3.50 per foot for the larger sizes. In the glaciated regions of Indiana the largest tubing, the so-called drive pipe, must extend the full thickness of the glacial drift and be set on the solid bed rock. The length of the drive pipe in this region varies from a few feet to more than four hundred feet. In the non-glaciated region except in the alluvial bottoms of rivers the drive pipe rarely exceeds one section of pipe.

A written contract is usually made between the driller and the operator. This contract binds the driller to drill to a certain depth for a certain specified sum per foot; to furnish all necessary equipment; to begin drilling within a certain specified period; to install the casing and to pull it in case of a dry hole. It binds the operator to furnish on the ground the drive pipe, casing, rodding, tubing and other accessories except such as are a part of the drilling equipment; he also allows the driller the use for fuel the oil or gas which exists or may be found in drilling.

Abandoning a Well. If a well is dry or the production too light to be profitable and the well is to be abandoned it must be plugged. The laws of Indiana provide that before the casing can be drawn from a well and abandoned, the nearest State Gas Inspector shall be notified and his presence secured. Under his direction the casing may be drawn and the well plugged.

Shooting Oil Wells. If after an oil well has reached pay sand the oil does not flow freely into the well as it is not likely to do in case of a close-textured rock it becomes necessary to shoot the well. Shooting is accomplished by lowering to the position of the oil sand a charge of nitroglycerine in cannisters. The amount of nitroglycerine used will depend upon the texture of the rock, the thickness of the pay sand, danger of flooding and other factors. The amount ordinarily used is from 60 to 100 quarts but the amount may be more or less. The explosive may be exploded by placing a fulminate cap on the charge in the well and dropping a conical iron, the "go-devil" upon it or by dropping a nitroglycerine "jack squib" bearing a fulminate cap upon the charge in the well (Fig. 22). Care must be taken not to get the charge below the pay sand because of the danger of flooding or of getting it above the pay sand in which case the shattered barren rock may interfere with production.

Pumping Oil Wells. When oil exists in the oil sand under great pressure it may be forced to the surface and a flowing well produced. Even a flowing well by decrease of pressure may cease to flow and require pumping. Some wells require pumping from the start. Wells may be pumped by separate power units or by central power units. A very common practice is to connect a number of wells, say six, with a central power plant

Fig. 21. View of an oil field in Indiana. (Amer. Inst. Min. Engineers.)

Fig. 22. Broad Ripple oil well after shooting.

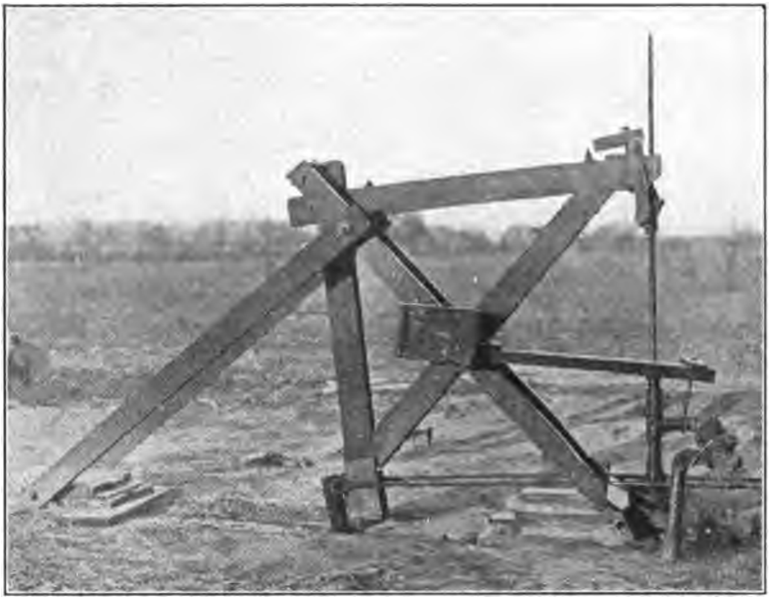

Fig. 19. Standard pumping jack.

Fig. 20. Steel pumping jack. (Ill. Geol. Survey.)

by means of rods which are attached at the well to pumping "jacks" which transform the horizontal pull of the rods into vertical movement of the pump rods in the well. (Figs. 19 and 20.)

Oil Transportation. The most efficient method of oil transportation is by pipe line, pipes laid underground through which oil is pumped. Pipe lines now carry oil from the mid-continental field to the Atlantic Coast. The pipe of the main lines have a diameter of eight inches and the feeders from three to six inches. Pumping stations are distributed at intervals along the main lines. Oil is also transported from the oil field to the refineries by tank cars and tank ships. Some oils, like certain Mexican oils, are too dense to be transported long distances through pipes and such oils are transported in tank cars or tank ships.

Oil Storage. Oil as it is brought from the wells, must be stored in tanks at least temporarily. If the oil field is near the refinery it may be pumped through pipe lines and kept moving from the field thus necessitating only temporary storage. When the field is located at a distance from the refinery and the means of transportation is by tank cars, large storage facilities are a necessity. Storage tanks are built of iron, wood or concrete, in cases of emergency reservoirs of earth, have been made. Tanks may be placed above or below ground. In some of the oil fields concrete tanks placed below ground are being constructed. Less evaporation and greater safety from fires, especial fires caused by lightning, are the claims made for them. The approximate dimensions of tanks of various capacity are given below:

Capacity in Barrels.	Height in Feet.	Diameter in Feet.
5,000	20	40
10,000	30	49-7/12
20,000	30	70
30,000	30	86
55,000	30	115

The gauging tanks range in size from 25 to 100 barrels and the oil is measured in these before being pumped to the storage tanks.

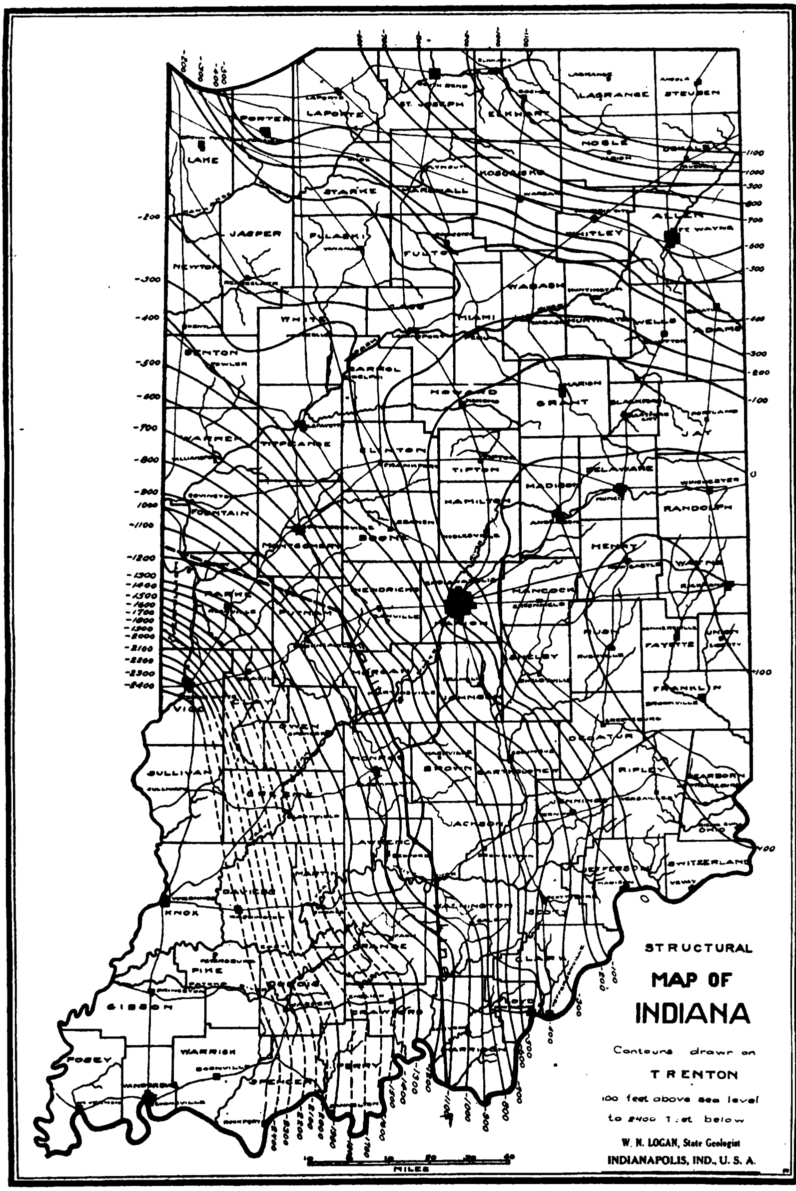

Fig. 24. Structural map of Indiana, contours drawn on Trenton.

CHAPTER VI

GENERAL GEOLOGICAL CONDITIONS IN INDIANA

The general geological conditions of Indiana are not complex. The rocks belong to the sedimentary division. The only rocks of igneous origin known in the State are the boulders which were carried into the State from the crystalline belt of rock lying far to the north. During a great part of the time that the rocks of Indiana were being deposited the sea occupied the whole or a part of the State. In this sea the fragments of disintegrated rocks of former ages were deposited to contribute to the strata which were later to form the surface of the State. The movement which was to convert the marine Indiana into dry land began on the eastern border and extended across the state northwesterly. Because of this differential uplift the southwestern and the northeastern corners of the State were the last portions to emerge from a gradually retreating sea. Though it is possible the emergence of the northeast corner may have antedated that of the southwest. (See next page for table.)

Potsdam Sandstone. The oldest rock reached by the drill in Indiana is a sandstone which is probably of the age of the Potsdam sandstone of the Cambrian period. Oil or gas has not been found in this formation in this or in the neighboring States. The formation does not outcrop at any point within the State. Wells have penetrated it to a depth of 300 feet without passing through it.

Lower Magnesian Limestone. Overlying the Potsdam sandstone is a limestone which is thought to be of the age of the Lower Magnesian. No outcrop of the formation occurs within the State. Its thickness as recorded in well records is about 300 feet. It is thought to be equivalent in age to the Calciferour of the New York section.

St. Peter's Sandstone. A number of deep wells in Indiana have passed through the Trenton limestone and pierced a stratum of sandstone which has been referred to the St. Peter's. The thickness of the sandstone as revealed by well records varies from 150 to 300 feet. It is thought to be equivalent in age to the Chazy of New York.

Trenton Limestone. Overlying the St. Peter's sandstone is a limestone which has been the source of the larger part of the oil and gas produced in the State. Portions of the upper part of the limestone have been rendered porous by dolomitization and where the structural conditions of the formation have been favorable oil or gas has been collected in these porous portions. The thickness of the Trenton limestone varies from 470 to 586 feet.

The geological formations which outcrop at the surface or have been revealed in deep wells in Indiana are given in the accompanying table.[1]

GEOLOGICAL SECTION OF INDIANA

Area	Period	Epoch	Formation	
Cenozoic	Quaternary	Recent	Alluvium, residual clays.	
		Pleistocene	Glacial drift.	
	Tertiary	Pliocene?	Gravels (Lafayette?).	
Paleozoic	Pennsylvanian	Allegheny	Merom sandstone.	
			Coal measures, coal, shale, etc.	
		Pottsville	Mansfield sandstone.	
		Unconformity		
	Mississippian	Chester	limestones, sandstones and shales.	
		St. Genevieve	Mitchel limestone.	
		St. Louis		
		Salem	Salem limestone.	
		Osage	Harrodsburg (Warsaw) limestone.	
			Knobstone shales.	
			Rockford (Goniatite) limestone.	
		Unconformity.		
	Devonian	Corniferous	New Albany shale.	
			Sellersburg limestone.	
			(Silver Creek limestone. Beachwood).	
			Geneva (Jeffersonville limestone).	
		Unconformity		
	Silurian		Louisville limestone.	
			Waldron shale.	
			Laurel limestone.	
			Osgood limestone and shale.	
			Brassfield.	
		Unconformity.		
	Ordovician	Cincinnatian	Richmond	Elkhorn.
				Whitewater sh. and Ls.
				Saluda, sh. and ls.
				Liberty, limestone.
				Waynesville, Sh. and ls.
			Maysville	Arnheim, shale.
				Mt. Auburn, ls.
				Corryville, ls.
				Bellevue, Sh. Ls. Ss.
				Fairmount, sh. and ls.
				Mt. Hope, sh. and ls.
			Eden	McMicken, sh. and ss.
				Southgate, sh. ss. ls.
				Economy
				Fulton.
			Trenton limestone.	
			St. Peters sandstone.	
			Magnesian limestone.	
	Cambrian		Potsdam sandstone.	

[1]For more complete discussions of the subdivisions represented in this table see reports by Ashley, Cummings, Foerste, Newsom, Price, Siebenthal, and others published in the Annual Reports of the Survey. For the subdivisions of the Chester see paper on "The American Bottoms," Indiana Studies, by C. A. Malott.

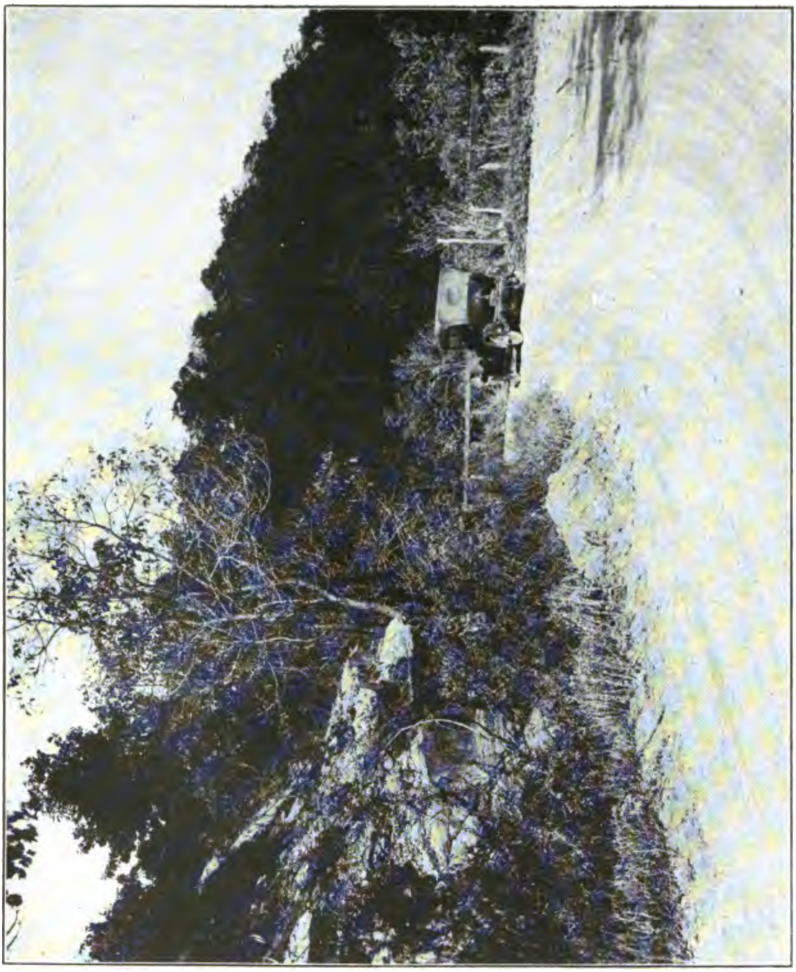

Fig. 25. Public road in the "Knobstone" formation near New Albany.
Photo by Hohenberger.

Cincinnatian. The group of limestones, shales and sandstones overlying the Trenton are usually referred to as the Utica and Hudson River shales in report pertaining to the oil industry of the State. These formations outcrop in the southeastern part of the State and they have been studied and their lithological and paleontological characters determined. The total thickness of the strata of this group is about 700 feet.

Silurian Strata. The formations belonging to the Silurian in Indiana consist chiefly of limestones with thin layers of calcareous shales. In the records of oil wells they are commonly referred to under the head, "Niagara limestone." Over much of the oil and gas territory in the eastern part of Indiana the first stratum of the durolith (bed rock) encountered by the drill is the Silurian limestone. The Silurian strata outcrop in the southeastern portion of the State and in the eastern portion where erosion has removed the glacial drift. The divisions represented in southern Indiana are: Brassfield limestone (Medina), the Osgood limestones and shales, the Laurel limestone, the Waldron shale and the Louisville limestone. The thickness of the Silurian in southern Indiana varies from 95 to 140 feet. The Waterlime is supposed to be represented in northern Indiana and the Schoharie by the Pendleton sandstone.

Devonian Strata. The lower portion of the Devonian consists of the Jeffersonville, the Silver Creek and the Sellersburg limestones. These outcrop in Clark, Jennings and other counties in the southern part of the State where they attain a total thickness of about ninety feet. In the well records these limestones are usually referred to as the Corniferous, though they are probably largely Hamilton. In many places it is sufficiently porous to allow the accumulation of oil and gas where structural conditions are favorable and some oil and gas production in Indiana is derived from the Corniferous. Above the Devonian limestone lies a black bituminous shale called the "New Albany" which is supposed to be of equivalent age to the Genessee of the New York section.

Mississippian Strata. The lowermost division resting on the New Albany is the Goniatite or Rockford limestone, a thin stratum, often only two feet thick, greenish color on fresh fracture but weathers brown. Overlying the Rockford is the New Providence shale member which is followed by the Knobstone shales and sandstones, containing some lenses of limestone. The term, Riverside sandstone was applied by Foerste to a sandstone in the Knobstone. The Knobstone sandstones frequently contain pockets of gas and there is reason to believe they may form oil reservoirs. The thickness of the Knobstone varies from 530 to 650 feet. The Harrodsburg (Warsaw) limestone overlies the Knobstone. The line of contact is marked by a large quantity of quartz geodes. The crystals in the interior of the geodes are usually quartz but in some calcite. This member consists of thin bedded limestone and shales. The limestones are irregularly bedded, very fossiliferous, contain chert, stylolites and coarsely crystalline calcite. Its thickness is from 60 to 90 feet. The Salem furnishes the Indiana oolitic building stone. It occupies in its outcrop, a narrow strip extending from Putnam County to Harrison County, the main quarry district being located

Fig. 26. An Oolitic (Salem) limestone quarry. The overburden which has been removed is Mitchell limestone. The first cut is being made in the upper surface of the Salem.

Fig. 27. Cave in Mitchell limestone in Harrison County. Caves and underground water courses are abundant in this limestone in Indiana and Kentucky. (Photo by Hohenberger.)

in Lawrence and Monroe Counties. The limestone occurs in a massive bed usually varying in thickness from 30 to 90 feet. The stone is a fine grained limestone, the grains being composed of shells or fragments of shells. It is generally recognized by its massiveness and granular (so called oölitic) structure.

The Mitchell is composed chiefly of limestone with some thin beds of shale in its upper horizon. It is a harder limestone than the oolitic and

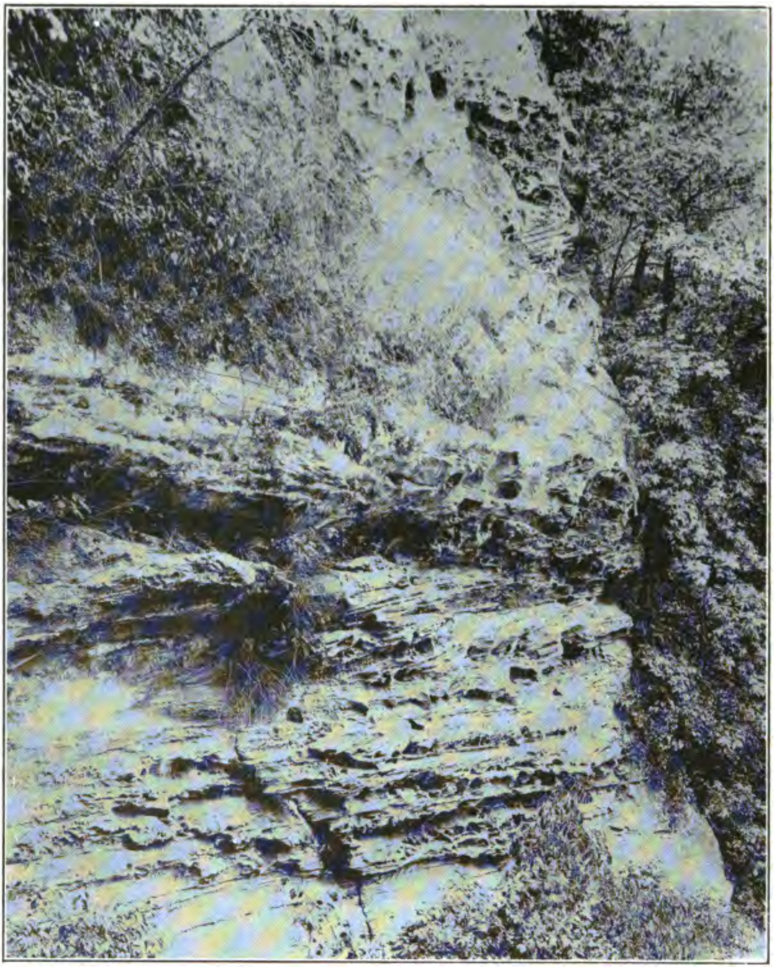

Fig. 28. An outcrop of Mansfield sandstone showing differential weathering, the more resistant parts are cemented with iron oxides. This forms one of the oil sands of southwestern Indiana. (Photo by P. B. Stockdale.)

is used much for road material. The individual beds of the limestone vary from two to thirty feet in thickness. Some of the layers of the upper portion contain inclusions of chert. Fine grained, lithographic stone is present in some horizons. The thickness of the Mitchell varies from 150 to 200 feet.

The Chester is composed of a series of sandstones, limestones and shales. The sandstones become oil reservoirs in southwestern Indiana, a portion of the oil production of that region being derived from them. Some

of the shales of the Chester are oil-bearing though they do not form reservoirs. Some of the limestones are of an oolitic character and some are lithographic. The sandstones are fine grained and are usually distinguishable from the coarser grained Mansfield.

Pennsylvanian Strata. A long period of erosion preceded the deposition of the Pennsylvanian rocks, and the surface of the Mississippian upon which the Pottsville rocks were deposited was very irregular. The Pottsville division is represented by beds of shale, thin beds of coal and a coarse sandstone, the Mansfield. The latter is often conglomeratic and in some places contains irregular masses of limonite. The Mansfield sandstone becomes an oil reservoir in the southwestern part of the State. Many of the shales associated with the coals of the Pottsville are oil bearing. There is an unconformity between the Pottsville and Allegheny divisions in Indiana which in some places is well marked.

Coal Measures. The rocks of the Allegheny division consist of shales, coals, limestones and sandstones. Many of the shales are oil bearing under destructive distillation. The sandstones furnish reservoirs in which oil and gas have accumulated at points where structural conditions are favorable. Many of the productive sands in Gibson and Pike Counties belong to the Coal Measures.

Merom Sandstone. This sandstone rests unconformably upon the Coal Measures in some places occupying erosion channels carved in the rocks of the Coal Measures. This sandstone is conglomeratic in its basal portions in some localities.

Tertiary. Some gravel beds which occur in southern Indiana consisting chiefly of chert and flint gravels with geodes probably belong to the Pliocene epoch of the Tertiary Period.

Quaternary. The Pleistocene or glacial deposits cover a large part of the surface of Indiana. There is an area in the southern part of the State lying south of the north line of Monroe County where the two lobes of the Illinoian glacier did not coalesce that was not glaciated. The deposit of glacial drift reaches a thickness of more than 400 feet in places. The presence of the drift has greatly interfered with the development of the oil and gas industry since it concealed the outcrop of the durolith and prevented the determination of structural conditions by direct observation. The strata of the Cincinnati geanticline are buried under the drift and its minor structural irregularities concealed.

The Recent deposits consist of residual clays, loam and soils formed from the decomposition of the durolith, alluvial deposits of the stream valleys, dunes of wind blown sand and marl and peat deposits.

Structural Features of Indiana. The major structural features of Indiana are comprised in the Cincinnati geanticline, the northern basin, the western basin and the Mount Carmel Fault.

The Cincinnati Geanticline which extends northward in Ohio sends off an arm which passes through Indiana in a northwesterly direction. The movement which inaugurated the arching took place during the Ordovician

period and continued until the close of the Carboniferous Period but while the movement resulted probably in land condition being produced in southern Ohio, the effect in Indiana was the production of a sub-marine ridge on the slopes and across the top of which the sediments of later periods were deposited. This ridge formed the dividing line between a basin on the north and one on the southwest. The younger rocks dip away from the ridge toward these basins. Sediments of Cambrian and Ordovician age were deposited on the eroded Pre-Cambrian surface before the elevation of the Cincinnati Arch. Through well records we learn that below the Trenton limestone which has a thickness of 500 or more feet there lies a sandstone which probably corresponds to the St. Peter's sandstone which outcrops in Wisconsin. Its thickness varies from 150 to 300 feet. That below the sandstone there is a limestone which probably corresponds in age to the Lower Magnesium limestone which has a thickness of about 300 feet and rests on the Potsdam sandstone which has a thickness of more than 300 feet. The Potsdam sandstone belongs to the Cambrian period and is the oldest rock known to occur in situ in Indiana.

The Northern Basin. The center of the northern basin lies north of Indiana about Bay City, Michigan. The southern limit of the basin is the Cincinnati Arch which passes across the State in a northwesterly direction. The sediments deposited in this basin range in age from the Silurian to and including the Coal Measures of the Pennsylvanian. It is very probable that the sediments of these formations were continuous across the arch at one time, but if so, they have been removed by erosion as only the Silurian rocks now rest below the drift and overlie the Ordovician on the top of the Arch. The dip of the strata from the top of the Arch northward is gentle at first not exceeding ten feet to the mile but the dip increases until it reaches thirty or more feet to the mile.

The Southwestern Basin. This basin has its center in southern Illinois toward which the formations laid down on the western and southern flanks of the Cincinnati Arch dip. The dip of the formations varies from thirty to fifty feet to the mile, perhaps in a few places exceeding fifty feet. The total thickness of the sediments deposited in this basin in Indiana on top of the Trenton is probably as much as 3,500 feet.

The Mount Carmel Fault. Early in the fall of 1916 the attention of the writer was attracted to a reversal of dip in some beds of limestone lying in eastern part of Monroe County. In places, this reversal of dip was noticeable in the limestones which overlie the Knobstone shales and sandstones, in other places in the sandstones of the Knobstone and again in beds of limestone occupying certain horizons in the Knobstone. Upon an investigation of the available geological literature I found in the Report of the State Geologist for 1896, pages 390-91, that Siebenthal discusses the Heltonville Limestone Strip as follows: "Commencing at Limestone Hill, eight miles southeast of Bloomington and extending east of southeast through Heltonville to, and probably beyond Fort Ritner, Lawrence County, is a band of limestone from one-half to one and a half miles in width, bordered sharply, both east and west, by Knobstone, and known in that neighborhood as the Limestone Strip. Isolated patches of similar limestone

occur north of this strip and in line with it. The strip is well developed in the vicinity of Heltonville, Lawrence County, where it gives exposures of the Harrodsburg, Bedford Oolitic and Mitchell limestones."

At many points the Knobstone contains intercalated lenticular beds of limestone, and it is possibly conceivable that the conditions which prevailed while these beds were being deposited might have been extended over a narrow territory like the Heltonville strip. However, the fact, first that Knobstone has not been found overlying this limestone, and second, that it shows the lithological facies of the Harrodsburg, the Bedford Oolitic and the Mitchell limestones, and the faunas of these formations, identifies it with them and shows conclusively that it is a narrow band of these formations, occupying a depression in the Knobstone, and not an included member of the Knobstone.

This depression may have resulted from a double fault or may be an old erosion channel. Some things seem to point to one as the origin and some to the other. The facts at hand incline us to the latter view. The most palpable objection to this view is the fact that no nonconformity exists between the Knobstone and the Harrodsburg limestone at their contact a few miles west of the strip. Another objection is that the bottom of the channel, at present at least, is not all of uniform elevation throughout its length. The principal objections to the view of a double fault are two—at no point was a direct vertical contact of Knobstone and limestone visible, nor was there to be seen any of the tilting, crushing and shattering which usually accompanies faulting. On the other hand, as the vicinity of the contact line is approached the shaly layers of the limestone become more and more argillaceous and apparently pass over into the Knobstone. To determine the exact conditions under which the limestone strip was laid down would require more extended study than is consistent with the scope of this report. What has been done was to trace upon the accompanying maps the outcrop of the Bedford Oolitic and to examine the bed more carefully at places where it is now being quarried, namely at Heltonville and Fort Ritner."

In the proceedings of the Academy of Science of Indiana for 1897, page 262, J. A. Price discusses the boundary of the limestone strip and says in conclusion: "It is not possible, from data in hand, to say surely whether this strip of limestone owes its existence to an unconformity or a fault."

In 1903 J. F. Newsom published a description of a "Geologic Section Across Southern Indiana" as a part of the 26th Annual Report of the State Geologist. On pages 274 and 275 Newsom refers to the structure as a fault in the Knobstone area. He gives its extent as being from near Unionville in Monroe County to a point in the northern part of Washington County.

In referring to the discussions of Siebenthal and Price in the 27th Annual Report of the State Geologist, 1903, on page 90, Ashley says: "It is evident that if the limestone strip north of White River is due to a fault its effects should continue to the south rather than turn and follow the outcrop. A glance at the map in the region north of Campbellsburg is alone sufficient proof of the fault character of the disturbance."

In studying this structure in detail the writer has found that it is much more extensive than Newsom stated; that there is a second fault; that

other disturbances were connected with it and that the actual contact which he has found presents some interesting features.

Extent of the Fault. While I have not yet been able to trace the fault to the borders of the State at either of its extremities I have been able to trace it far beyond its mentioned boundaries and feel confident that the particular disturbance under discussion extended from the Ohio to the Wabash along the western border of the Knobstone outcrop and perhaps beyond. Tracing the fault south of Campbellsburg in Washington County is difficult because the area on each side of the rift is occupied by limestone.

Along the northern end of the displacement glacial deposits conceal the bedrock to such an extent as to render observation difficult. Under these circumstances the best that can be done is to trace the disturbance by the reversal of dip of the limestones, as the finding of the rift will be extremely difficult. By such observations as it was possible to make I have traced the disturbance from a point southeast of Campbellsburg in Washington County to a point northwest of Waveland in Montgomery County.

Rift. The actual contact of the rocks along the fault plane is revealed in only a few places. There are numerous places where the harder more resistant stratum of limestone stands forth like a wall on one side of the rift, but the opposite side is occupied by mantle rock which was derived by the weathering of the Knobstone and which conceals the actual rift. Excavations made at such places would doubtless reveal the actual contact of the limestone and the Knobstone.

In a few localities the rift is exposed and the plane of the fault is bordered on the one side with limestone and on the other by shale. One outcrop of the rift zone was found in the bed of the north fork of Leatherwood Creek near Heltonville. At this point the Knobstone occurs on one side of the fault plane and the Harrodsburg limestone on the other. The line of rift is distinct, being marked by a thin bed of breccia. The brecciated zone is composed mainly of fragments of limestone in which small fragments of shale are intermingled. These fragments have been cemented together with calcite and the whole zone more or less marbleized. In a cross-section of the brecciated rock the veins of calcite stand out clearly, as they are whiter than the fragments of limestone and shale which they bind together. Small quantities of other minerals are present in some parts of the brecciated zone, but there is an absence of the more insoluble minerals, such as silica or the silicates. This fact leads to the conclusion that meteoric rather than thermal waters have played the leading role in the concentration of these minerals.

Periods of Movement. The question of whether the displacement took place all at one time or was intermittent is an interesting one. All of my attempts to find an evidence of intermittent movement by an examination of surface features have been unsuccessful. If there were intermittent movements of any considerable extent we would probably find them revealed in hanging valleys on the upthrow side and the rapid broadening of valleys on the downthrow side of the fault. In case there were two stages of movement, and the movement in the last stage an exceedingly slow one,

the vertical cutting of the main stream might be as rapid as the uplift, but still the rejuvenation of the tributaries should result in a narrowing of the valleys. In the rift zone there is evidence of two stages of movement though the amount of displacement in the second stage is slight. The time interval between the two movements was of considerable length, since the fragments of the brecciated zone were firmly cemented before the second movement took place. Fragments of shale which were included in the limestone fragments during the first movement were faulted by the second movement. These shale inclusions would not have undergone faulting had they not been held rigidly in place by the cementing material.

Amount of Throw. The amount of throw of the fault varies probably from 200 to 300 feet. Opportunities for measuring the amount of throw are not numerous. It can best be computed by estimating the total amount of eastward dip of the formations along the line of contact between the Harrodsburg and the Knobstone. At a point south of Mt. Carmel the difference in elevation of the contact above sea level is 50 feet in a distance of one-fourth mile. Since the width of the down-thrown block is at least one mile and a half in this locality the throw of the fault is at least 300 feet. The amount of dip of the down-thrown beds in other localities is less than at this point, so much less that the indicated throw is not more than 200 feet.

Age of the Fault. The time at which the dislocation occurred can not be fixed definitely. It is probable that it occurred at the close of the Paleozoic Era when the Appalachian revolution which resulted in the elevation of the eastern part of North America took place. Contemporaneous with or subsequent to that great epeirogenic movement, faulting and minor folding took place in Indiana, Illinois and Iowa, and other States lying as far west as these from the region of maximum disturbance. These faults like the one under discussion have a northwest disturbance.

The Heltonville Fault. About one mile west of the Mt. Carmel fault there is a second fault. This I have named the Heltonville Fault because the rift is exposed a short distance east of Heltonville in the bed of the north fork of Leatherwood Creek, at a point just east of the wagon-crossing under the Southern Indiana railroad. This fault lies approximately parallel with the Mt. Carmel fault. The limestone has been faulted down against the Knobstone. Slickenslides have been produced in the limestone and it has been much fractured. In places the limestone has been thrust backward and fragments of the Knobstone shales have been thrust into the limestone. In places these formations are dovetailed, fingers of limestone projecting into the Knobstone and vice versa as first one and then the other yielded to the pressure. The fragments of limestone containing inclusions of shale have been united by calcite veins.

Though the fault character of the disturbance at this point is incontestable it is not equally clear at other points. The disturbance extends both north and south of this point, but it probably passes into a fold in both directions. In Monroe County near Unionville there is an anticline which occupies about the same position in relation to the Mt. Carmel fault

as the Heltonville fault does. Similar folds have been noted at intervening points and also to the south of Heltonville.

Effect Upon Topography. The general effect upon topographic conditions within the area of disturbance has been to produce a narrow limestone belt extending parallel with the main Knobstone outcrop and bordered on each side by outcrops of Knobstone. In the southern portion of the faulted area the western belt of Knobstone is absent, but its nearness to the surface along the line of the eastward reversal of dip is revealed in the channels of many streams which have carved their valleys at right angles to the line of reversal. Probably the most marked effect is on the drainage. Both surface and underground drainage lines are affected. In the faulted area the ground waters which have found their way through the limestone have a tendency to follow the eastward sloping surface of the Knobstone to the rift, and near this point often come to the surface in a stream valley which lies near the rift and generally parallel with it. This tendency of the underground streams is modified by local dips of the strata north or south.

The surface streams, especially those along the line of the fault plane, have been influenced by the displacement. They have worked off the harder limestones on to the Knobstone in many places. These follow the line of rift until a local north or south dip has caused them to change the direction of their course. Small tributaries of the larger cross-cutting streams have developed, as has been noted again and again, along the line of rift.

The Mount Carmel Fault is one of the most important structural features in Indiana. It extends from near the Ohio River northward to the north part of Putnam County and possibly extends in a westerly and northwesterly direction from that point to the western boundary of the State. The extent of its throw in places exceeds two hundred feet. In a general way it parallels the western limits of the Knobstone outcrop. The downthrown side is west of the fault line. The faulting and the subsequent erosion has resulted in a limestone belt bordered on the east and west by Knobstone, the limestone being on the down throw side and thus protected from the erosion which caused the removal of the limestone of the same age lying at a higher elevation both east and west. Since the normal dip of the rocks is southwest the downward drop of the block toward the east resulted in a fold lying parallel with the fault plane to the west. As the fault changes its directions in some places north and south components of dip are produced in the fold at such places and conditions favorable for the accumulation of oil and gas produced. One such place occurs in Lawrence County and considerable gas and a showing of oil obtained west of Leesville. Another favorable structure exists near Unionville in Monroe County.

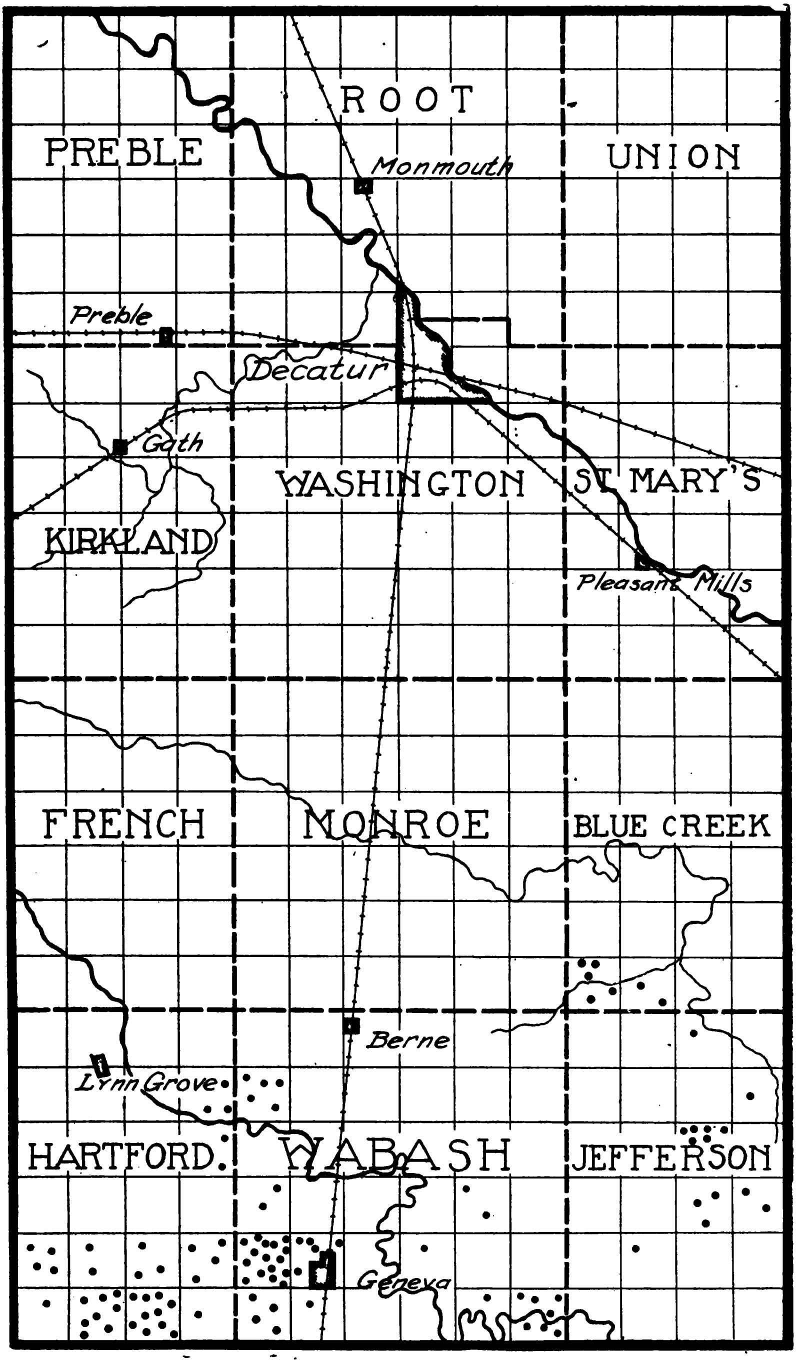

Fig. 29. Map of Adams county showing location of wells. The southern tier of townships is in gas and oil territory.

CHAPTER VII.

ADAMS COUNTY

Adams County lies within the glaciated area of Indiana, hence its bed rock (durolith) is covered with a thick over-burden of glacial drift (regolith). The latter varies in thickness from a few feet to eighty or more. It conceals the eroded surface of the Silurian (Niagara limestone). Beneath the Silurian strata lie the shales of the Ordovician which rest upon the Trenton limestone, within porous portions of which oil has been found in this county. The structural conditions cannot be determined in this county by surficial observations. Enough wells have been drilled in the county to furnish sufficient data for outlining the structural conditions, but unfortunately these records have not been preserved, and so the minor irregularities on the surface of the geanticline cannot be located.

Railroad Elevations.

GRAND RAPIDS AND INDIANA RAILROAD.

Location	Feet above Sea Level	Location	Feet above Sea Level
Geneva	840.5	67th mile post	812.6
55th mile post	849.7	68th " "	808.7
56th " "	833.2	69th " "	803.5
57th " "	845.2	70th " "	801.8
58th " "	847.4	Decatur	799.2
59th " "	838.7	71st " "	797.7
60th " "	841.3	72nd " "	786.4
61st " "	840.3	73rd " "	794.0
62nd " "	826.2	Monmouth	789.7
63rd " "	839.2	74th " "	789.0
64th " "	825.3	75th " "	810.0
Monroe	823.8	76th " "	817.5
65th " "	823.2	77th " "	816.1
66th " "	817.2	Williams	826.2

TOLEDO, ST. LOUIS AND WESTERN RAILROAD.

State line	800.7	112th mile post	815.6
101st mile post	795.9	113th " "	822.0
102nd " "	802.7	Peterson	817.0
Pleasant Mills	799.4	114th " "	823.8
104th mile post	797.0	115th " "	829.0
105th " "	800.1	116th " "	835.6
106th " "	804.0	117th " "	846.3
107th " "	802.2	118th " "	851.0
108th " "	795.6	119th " "	859.5
Decatur	800.3	120th " "	855.2
109th " "	804.9	121st " "	830.3
110th " "	809.0	122nd " "	824.0
111th " "	815.0	123rd " "	814.5

CHICAGO AND ERIE LINE.

Bridge No. 49	799.0	Bridge No. 53	800.0
Decatur	799.0	Bridge No. 56	809.0
Magley	830.0		

Oil has been produced in the southern tier of townships and in Blue Creek Township. The production was heaviest in Hartford Township.

Washington Township. The following is the record of a well drilled at Decatur as given by Phinney[1]:

Decatur Well.

Drift	47	feet.
Limestone	436	"
Bluish Shale	667	"
Black shale	110	"
Trenton limestone	40	"
Total depth	1300	feet.
Altitude of well	800	"

Blue Creek Township. Wells in sections 8, 9, 10, 15, 16, 17, 21, 22, 27, 28, 29, 30, 31, 32, 33, and 34. Light oil production was obtained in 15, 16, 22, 27, 29, 30, 31, 32, and 34. In 1916 five wells were abandoned in section 31 and two in section 32. Dry holes were drilled in sections 8, 9, 10, 15, 17, 21, 28, 29, 30, and 33. Gas was obtained in section 16.

Hartford Township. The most productive territory was found in this township. Oil production was obtained in sections 12 to 36 inclusive. Dry holes were drilled in sections 4, 7, 8, 12, 14, 15, 16, 17, 18, 22, and 23. Some of the wells had an initial production of 180 barrels per day. Thirteen wells were drilled in the northeast quarter of section 25, the average depth of the Trenton being 1004 feet and the average initial production being one hundred barrels per day[2]. The record of a well drilled on the southwest quarter of section 25 is given by Blatchley[2] as follows:

Record of Well in Section 25.

Drive pipe	110	feet.
Casing	230	"
Trenton struck at	996	"

Initial production 150 barrels.

Production in October, 1896, two barrels.

A large number of wells have been abandoned in this township, a partial list is given below:

The wells abandoned in this township are located as follows:

Sec.	wells	Sec.	wells	Sec.	wells
12	3	25	4	34	8
13	2	26	3	35	10
17	1	28	4	36	1
20	1	33	1		

Jefferson Township. Production has been obtained in this township from sections 4, 5, 6, 10, 16, 18, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32 and 34. Dry holes were drilled in sections 3, 7, 8, 10, 15, 16, 17, 18, 22, and 33. Gas was obtained in 16 and 34. The initial production of oil ranged as high as one hundred barrels per day. Abandoned wells are located in section 4, one well; section 10, one well; section 16, seven wells; section 21, three wells; section 22, two wells; section 29, one well.

Wabash Township. Light production was obtained in sections 18, 19, 20, 27, 28, 29, 30, 31, 32 and 36. Dry holes were drilled in sections 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 32, 33, 35, and 36. A partial list of the wells abandoned is given below:

Sec.	wells	Sec.	wells	Sec.	wells	Sec.	wells
7	5	27	1	31	4	36	7
19	2	29	5	32	1		
23	2	30	23	35	1		

In Adams County 880 wells have been abandoned only a partial list of which has been recorded.

ALLEN COUNTY

The durolith of the northern portion of Allen County is composed of strata of Devonian age, but for the remainder of the county it is composed of Silurian strata. The regolith, which is composed mainly of glacial drift, varies in thickness from one hundred to three hundred feet. Irregularities in the surface of the durolith, irregularities of decomposition and post glacial erosion, account for the difference in thickness of the drift. This county lies largely on the side of the Cincinnati arch dipping toward the north basin. The dip of the surface of the Trenton northward from Ft. Wayne is at the rate of twelve and one-half feet to the mile. At Ft. Wayne the surface of the Trenton lies about 650 feet below sea level, at Stoners near the north line of the county, it is 860 feet and near New Haven it is about 680 feet below sea level. Not enough well records are available to determine accurately the structural conditions and sub-surface work is the only possible source of information on account of the concealment of the durolith. The following are some of the railroad elevations in the county:

Railroad Elevations.

Fort Wayne	757.3	Fort Wayne	779.0	New Haven	758.6
State Line	757.8	Dixon	793.5	Gorham	817.8
Fort Wayne	765.1	Carroll	852.6	Washington	811.9
East Yard	802.3	Dawkins	769.1	Maples	790.5
Huntertown	841.6	Hoagland	826.7	Stoner's	837.7
Academie	829.9	Junction	764.4	Wab. Crossing	757.8
Edgerton	758.3	Monroeville	789.6	Adams	790.9
Hadley	840.1	Huntertown	871.1	Wallen	854.6
				Adams	791.9

Wayne Township. Four wells were drilled at Fort Wayne. They range in depth from 1000 to 3000 feet. The records[1] of Nos. 1 and 2 follow:

Section of Well No. 1, Nov. 18, 1886.

Drift	77	feet.
Water-lime	30	"
Niagara	570	"
Hudson River and Utica	751	"
Trenton limestone	15	"
Total depth	1443	feet.
Trenton below sea level	693	"

Gas with an initial pressure of 160 pounds per square inch was found upon entering the Trenton rock at a depth of 1428 feet; at a depth of 1431 feet a considerable quantity of oil was found.

Section of Well No. 2.

Drift	110	feet.
Lower Helderburg	34	"
Niagara limestone and shale	571	"
Hudson River limestone and shale	410	"
Utica shale	312	"
Trenton limestone	21	"
Total depth	1458	feet.
Trenton below sea level	650	"

Yielded no gas. Salt water, however, was found in considerable quantities.

Below is given the record of a well drilled in Perry Township[1]:

Section of Well Drilled on Sec. 4, Twp. 32, R. 12.

Surface above sea level	844	feet.
Drift	281	"
Limestone	749	"
White shale	430	"
Black shale	240	"
Trenton limestone	52	"
Total depth	1752	feet.
Trenton below sea level	856	"

Did not strike gas, oil or salt water. The dip of the surface of the Trenton from Fort Wayne to this point is about twelve and one-half feet to the mile.

Adams Township[2]. N. E. ¼ of section 14 in 1899 made a fair showing of oil, but a second bore resulted in a dry hole. A third bore resulted in a well, described below:

Drive pipe	96	feet.
Casing	700	"
Top of Trenton	1440	"
Total depth	1496	"

Several bores were drilled on the farms adjoining the above, but resulted in dry holes.

Jackson Township[1]. Section 3, bore completed on the Amspaugh farm, started with an output of twelve barrels per day. Section 33, a test well was drilled in October, 1903, which resulted in about eighteen barrels.

Monroe Township. A large showing of oil in section 3, also a big supply of gas; caught fire before the drilling was completed. A well in section 3, on the C. K. Dresser property was abandoned in 1919.

BARTHOLOMEW COUNTY

The glacial drift covering Bartholomew County varies in thickness from five to more than one hundred feet. Underlying the drift in the eastern part of the county are strata of Silurian and lower Devonian age, while in the western part the strata are of the upper Devonian and lower Mississippian age. The Silurian rocks are limestones largely, the Devonian, shales and limestones, and the Mississippian, shales and sandstones.

The structural conditions are not easily determined on account of the glacial drift which conceals the outcrop of the bed rock strata. If the proper geological structures exist, it is possible that oil and gas may be found in the Devonian and the Trenton in the western part of the county and from the Trenton in the eastern part of the county. The Trenton lies below the surface at depths ranging from 800 to 1200 feet.

The record of a well drilled at Columbus is given below:

Section of Well No. 1[2].

Drift	26	feet.
Devonian shale	87	"
Corniferous limestone	32	"
Niagara limestone	235	"
Hudson River limestone and shale	440	"
Utica shale	135	"
Trenton limestone	155	"
Total depth	1110	feet.

Yielded no gas.

Elevation on Railroads.

Columbus, 627.3; Clifford, 668.3; St. Louis Crossing, 679.5; Wiggs, 615.9; Elizabethtown, 615.8; Waynesville, 601.7.

BENTON COUNTY

Rock strata belonging to the Devonian, Mississippian and the Pennsylvanian periods underlie the Pleistocene deposits in Benton County. The latter attain a thickness of from 75 to 350 feet. The bed rock strata dip toward the southwest. The Trenton limestone may be reached at a depth of from 800 to 1100 feet, depending upon the surface elevation and

location in the county. The structural conditions in the county cannot be determined by surficial methods, and the use of a large number of well records will be necessary in order to gain even a general idea of structural conditions. Without such data, prospecting for oil in this county will be, of necessity, with the drill and attended with exceptional risks.

The following is the reported record of a well at Fowler:

Section of Well No. 1.

Drift	280	feet.
Devonian black shale	92	"
Corniferous limestone	40	"
Niagara limestone	328	"
Hudson River and Utica	255	"
Total depth	995	feet.

Railroad Elevations.

Wadena, 800.0; Lochiel, 795; Barce, 808; Swanington, 796; Oxford, 736; State line, 706; Freeland, 720; Atkinson, 712; Gravel Hill, 780; Sheff, 727; Sheldon, 680; Iroquois, 649; Otterbein, 705.3; Vilas, 707; Templeton, 669; Fargo, 771; Chase, 738.3; Boswell, 756.3; Talbot, 763.8; Handy, 743; Ambia, 730.6. The elevations above given used with well records and records of outcrops and an aneroid barometer in the hands of a trained geologist may be the means of determining the structural conditions in this county.

BLACKFORD COUNTY

The mantle rock in Blackford County is glacial drift varying in thickness from 15 to 150 feet. The drift rests on the Niagara limestone which has been eroded by preglacial streams and varies in thickness with the configuration of that surface. The Silurian (Niagaran) limestone has a thickness of 200 to 350 feet at least. The underlying Ordovician shales (Hudson River and Utican) reach a thickness of 600 feet, while the Trenton limestone has a thickness of about 500 feet.

Licking Township. Producing oil and gas wells have been drilled in this township. The following well records were reported by Gorby[1]:

Hartford City.

	Well No. 1		Well No. 2	
Drift	130	feet.	82	feet.
Niagara limestone	350	"	280	"
Hudson River and Utica	473	"	573	"
Trenton limestone	30	"	32	"
Total depth	983	feet.	967	feet.
Trenton below sea level	70	"	40	"

The first gave a strong flow of gas and the second a very strong flow.

[1]Gorby, S. S., Ind. Geol. Sur. 1888, p. 247.

Another well located near the Fort Wayne and Muncie Railroad depot was reported by Phinney[2] as follows:

Drift	125 feet.
Limestone	200 "
Shale	622 "
Trenton limestone	35 "
Total depth	982 feet.

The elevation of the station is 887.6 feet above sea level.

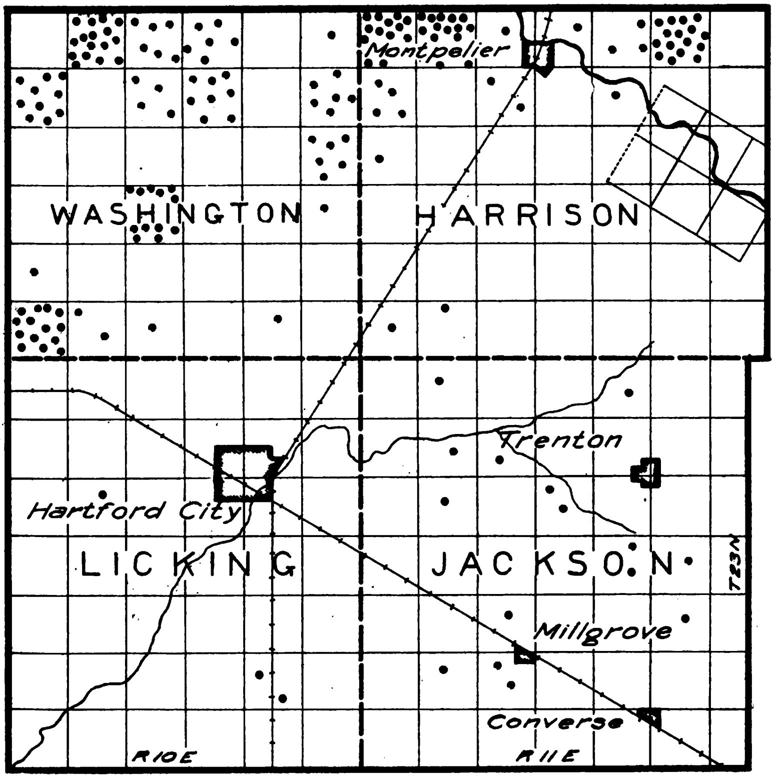

Fig. 30. Map of Blackford County, showing abandoned wells. Washington and Harrison Townships were oil territory and Licking and Jackson gas territory. A little oil was produced in Licking in the northern part.

Since the altitude of the mouth of the well is given at 895, the top of the Trenton would lie 52 feet below sea level. This well at first had a flow of gas of 850,000 cubic feet per day; by drilling deeper it was increased to 2,787,000 cubic feet per day. A second well was drilled half

[2]Phinney, A. J., 11th Ann. Rept. U. S. G. S., p. 679.

a mile southwest of the first and the Trenton reached at 935 feet. This well flowed 7,982,000 cubic feet per day.

A well drilled north of Hartford City reached gas at 980 feet and had a daily capacity of 6,383,000 cubic feet. Gas wells were located in this township in sections 5, 7, 8, 17, 19, 20, 21, and 27. Oil wells were located in sections 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 14, 16, 18, 22, and 27. The following wells have been plugged: Section 1, one well; section 2, one well; section 6, nine wells; section 8, one well; section 10, four wells; section 11, three wells; section 14, one well; section 15, one well; section 17, one well; section 29, one well; section 35, two wells.

Harrison Township. A well drilled at Montpelier reported by Dr. C. Q. Sholl[1] gives the following section:

1.	Drift	16½	feet.
2.	Gray limestone	23	"
3.	Gravel, 14 ft. and red clay, 16 ft.	30	"
4.	Gray limestone	180	"
5.	Shale (Niagara)	38	"
6.	Bluish limestone	65	"
7.	Bluish shale	35	"
8.	Brownish limestone	35	"
9.	Bluish shale	35	"
10.	Gray limestone	8	"
11.	Bluish green shale	160	"
12.	Brown shale	50	"
13.	Bluish shale	18	"
14.	Black shale	280	"
15.	Trenton limestone	11½	"
	Total depth	975	feet.

The elevation of the station at Montpelier is 867.0 feet above sea level.

The following wells have been plugged in this township: Section 1, 16 wells; section 3, 1 well; section 4, 1 well; section 5, 14 wells; section 6, 13 wells; section 7, 4 wells; section 9, 2 wells; section 16, 1 well; section 18, 1 well; section 30, 2 wells; section 31, 1 well; section 32, 1 well.

Washington Township. All the sections in the township have produced oil, and gas has been obtained from sections 23, 24, 31, 32, 35, and 36, R. 11 E., oil in 6, 7, 18, 19, 30, and gas in 19 and 30, R. 12 E.

Wells have been plugged as follows: Section 1, 1 well; section 3, 6 wells; section 4, 6 wells; section 5, 23 wells; section 7, 10 wells; section 9, 4 wells; section 10, 8 wells; section 12, 6 wells; section 13, 6 wells; section 21, 12 wells; section 24, 1 well; section 30, 1 well; section 31, 14 wells; section 32, 2 wells; section 33, 1 well; section 35, 1 well.

Jackson Township. Sections 6 and 7 produced oil. Gas was found in sections 5, 17, and 18. Wells have been abandoned in the following sections: Section 2, 1 well; section 5, 1 well; section 8, 1 well; section 9, 1 well; section 15, 2 wells; section 17, 1 well; section 23, 2 wells;

[1]Phinney, loc. cit.

section 24, 1 well; section 25, 1 well; section 28, 1 well; section 32, 1 well; section 33, 1 well.

Anna C. Simonton Farm, Sec. 15, Harrison Twp.:

Sand and gravel	134	feet.
Limestone	138	"
Shale	725	"
Trenton rock	42	"
Total depth	1039	feet.

Lewis Blount Farm, section 14, Harrison Township, Blackford County:

Sand and gravel	118	feet.
Limestone	162	"
Shale	700	"
Trenton rock	47½	"
Total depth of well	1027½	feet.

More than 1398 wells have been abandoned in this county.

BOONE COUNTY

Strata of Devonian age form the durolith which underlies the eastern and central portions of the surface of Boone County, while strata of Mississippian age underlie the western portion. These strata are concealed by the glacial drift which varies from fifty to one hundred and fifty feet in thickness. The strata of the durolith which are recognizable from the well records are:

Mississippian	Shales and sands—Knobstone
Devonian	Shale—New Albany Limestones
Silurian	Shale Limestones—Niagara (?)
Ordovician	Shales—Utica and Hudson River Limestone—Trenton

The structural conditions in Boone County cannot be determined by the use of surficial observations. Deep well records are not sufficiently abundant to furnish the data for subsurface work.

Railroad Elevations.

Zionsville, 842; Whitestown, 928; Hazelbrigg, 904; Terhune, 940.8; Max Station, 922; Advance, 928.

A well drilled at Zionsville is reported as follows[1]:

Drift	160 feet.
Black shale (trace)	75 "
Devonian limestone, with sandstone at base	75 "
Lower Helderburg and water lime	50 "
Niagara limestone	165 "
Clinton limestone	30 "
Hudson River and Utica	525 "
Trenton limestone	33 "
Total depth	1038 feet.
Altitude of well	777 "

A well drilled at Thorntown has the following record:[2]

Drift	65 feet.
Sub-carboniferous limestone and shale	338 "
Hamilton shale	87 "
Corniferous limestone	37 "
Niagara limestone	405 "
Hudson River and Utica	373 "
Trenton limestone	80 "
Total depth	1287 feet.
Trenton below sea level	394 "
Yielded no gas.	

A well was drilled at Lebanon, Indiana to a total depth of 1800 feet. Depth to Trenton, 1227 feet. Trenton below sea level 302 feet. No gas. The record of this well as given by Phinney is as follows:

Drift	210 feet.
Blue and black shales	204 "
Limestones	401 "
Shale	412 "
Trenton limestone	373 "
Total depth	1600 feet.
Altitude of well	925 "

BROWN COUNTY

The northern part of Brown County lies within the glaciated area but the greater part of the county furnishes good rock exposures as the topography is of a rugged type. Even though the strata are not concealed by glacial drift the determination of the structure is difficult on account of the absence of persistent layers of rock. A lense or perhaps several lenses of limestone occur about one hundred feet below the upper surface of the Knobstone group. These lenses may be used locally as datum for mapping the structure. Sandstone layers occur at many horizons in the Knobstone

but they are unreliable because of their lenticular character and cross bedded nature.

Trevlac. A well was drilled on the Bullhimer farm two miles north of Trevlac. The drill passed into the Trenton limestone at 1460 feet. The upper part of the limestone was fossiliferous, porous and contained a showing of gas. The drill passed through the Trenton at 2056 feet, showing 596 feet of limestone.

Johnson Township. A well was drilled in section 7 in Johnson Township and a showing of gas was obtained.

The elevation of the surface on the railroad at Trevlac is 654; Helmsburg, 676; Fruitdale, about 797.

CARROLL COUNTY

A small area around Delphi, another one in the northern part of the county and another in the eastern portion is occupied by the Niagara limestone as a bed rock formation, the remainder of the county is occupied by the Devonian strata. The bed rock is largely concealed by glacial drift but outcrops occur to a limited extent along the Wabash River and some of its tributaries.

The following are the records of two wells drilled at Delphi:[2]

Niagara limestone	587	feet.
Hudson River limestone and shale	220	"
Utica shale	93	"
Trenton limestone	12	"
Total depth	912	feet.
Trenton below sea level	334	"

Yielded no gas.

Section of Well No. 2

Niagara limestone	565	feet.
Hudson River and Utica shale	351	"
Trenton limestone	434	"
Potsdam sandstone	12	"
Total depth	1362	feet.
Trenton below sea level	350	"

Yielded no gas.

Recently attempts were made to drill in the Niagara mound at Delphi under the assumption that it represented an anticline. There is reason to believe that this dome may be only the remnant of an ancient reef.

Railroad Elevations

Cutter, 722.7; Bringhurst, 718.7; Flora, 699.7; Camden, 659.7; Woodville, 692.7; Pattons, 682.4; Lennox, 663.7; Sleeths, 657.8; Wabash River, 647; N. Delphi, 557; Delphi, 555; Deer Creek, 672; Harley's, 693.5; Ockley, 695; Orvasco, 701.

CASS COUNTY

Strata of Silurian and Devonian age underlie the surficial deposit of glacial drift in this county. The determination of structural conditions from surficial observations is prevented by the glacial mantle.

A well drilled at Galveston furnishes the following sections:

Section of Well No. 1[2]

Drift	40 feet.
Corniferous and Niagara limestone	410 "
Hudson River and Utica	480 "
Trenton limestone	20 "
Total depth	950 feet.

Yielded no gas.

At Logansport a well is reported to have:

Depth to Trenton	995 feet.
Trenton below sea level	344 "

Yielded no gas.

A second record was constructed by Phinney from drillings kept by Dr. J. H. Shultz:

Upper Helderburg limestone	40 feet.
Lower Helderburg limestone	30 "
Water lime	108 "
Bluish limestone, Niagara	55 "
Argillaceous limestone	110 "
White and gray limestone	135 "
Bluish green shale (Niagara)	2 "
Clinton limestone steel gray, red grain	53 "
Hudson River limestone and shales	90 "
Utica shale	281 "
Trenton limestone	200 "
Total depth	1104 feet.
Altitude of well	611 "

Section of well at Royal Center:

Drift	105 feet.
Niagara limestone	485 "
Hudson River	220 "
Brown shale, Utica shale	110 "
Trenton limestone	42 "
Total depth	962 feet.

Three wells were drilled in this county in 1909, two were reported dry and the third as showing small production.

CLARK COUNTY

The greater part of Clark County lies within the unglaciated area but the northeastern part of the county is covered with glacial drift. The strata represented by the outcrops of the county are given in the following table:

Quaternary		Recent: Clays and alluvium
		Pleistocene: Clays, gravels & sand
Mississippian		Mitchell limestone
		Salem limestone
		Harrodsburg limestone
		Knobstone, sandstone and shales
		Rockford limestones
Devonian		New Albany shales
		Sellersburg limestones
		Silver Creek limestone
		Jeffersonville limestone
Silurian		Louisville limestone
		Waldron shale
		Laurel limestone
		Osgood limestone and shale
		Brassfield shale
Ordovician	Richmond	Elkhorn
		Whitewater
		Saluda
		Liberty
		Waynesville
		Arnheim
	Maysville	Mt. Auburn
		Coryville
		Bellevue
		Fairmount
		Mt. Hope

The determination of structural conditions favorable for gas or oil, if such exist, seems possible in this county because of the absence of glacial drift and the rugged condition of the topography which produces many outcrops of the strata. Key formations such as the Louisville limestone, the Sellersburg and the Harrodsburg may be used to advantage in locating structures. In the eastern part of the county the Trenton limestone is a possible source of gas and oil if favorable conditions exist. In the western portion the Trenton, Silurian and the Devonian limestones may furnish oil or gas reservoirs

The following is the record of a well drilled at Jeffersonville:

Section of Well No. 1

Alluvium	45 feet.
Devonian limestone	40 "
Niagara limestone	105 "
Clinton limestone	20 "
Hudson River limestone and shale	646 "
Depth to Trenton	856 feet.
Trenton below sea level	401 "

Yielded small flow of gas.
Some gas was obtained from a well north of Jeffersonville.

CLAY COUNTY

The portion of the Geological column represented by the outcrops in this county is given below:

Quaternary	Recent: Alluvial sands and clays Pleistocene: Glacial sands, gravels and till
Pennsylvanian	Allegheny: Limestones, sandstones, shales and coals Pottsville: Conglomerate, sands, shales and coals
Mississippian	Chester: Shales, sandstones and limestones

On account of the thickness of the mantle of Pleistocene and Recent, outcrops of the bed rock are not numerous but some of the streams have cut through the mantle and revealed the bed rock. Coal strip pits have also uncovered the strata in limited areas. The determination of structural conditions will require the use of sub-surface data, such as the record of wells, coal shafts, etc. Careful discrimination between Pottsville coals and Allegheny coal will be necessary as the use of the latter for key horizons is not always safe, as there is some evidence of a post-Pottsville disturbance.

The following is the record of a well drilled east of Jasonville. These records were obtained from Jesse Liston of Lewis:

Sheets Drill East of Jasonville

	Feet		
Surface clay	0	to	15
Sandstone	15	"	30
Shale	30	"	36
Coal	36	"	38
Blue fire clay	38	"	50
Water sandstone	50	"	75
Shale	75	"	100
Water sandstone	100	"	130
Blue shale, soft	130	"	150
Water sandstone	150	"	170
Blue shale, soft	170	"	282
Coal	282	"	286

	Feet		
White shale, soft	286	"	305
Sandstone	305	"	328
Shale	328	"	338
Water sandstone	338	"	352
Shale	352	"	408
Sandstone	408	"	452
Blue shale	452	"	520
Water sandstone	520	"	580
Hole full of water			550
Shale	580	"	586
Limestone	586	"	643
Shale	643	"	653
Blue shale, soft	653	"	668
Limestone	668	"	850
8¼ in. casing at			740
White limsetone, soft	850	"	855
Brown limestone	855	"	875
White limestone, soft	875	"	885
Brown limestone	885	"	925
White limestone, soft	925	"	932
Brown limestone	932	"	987
Water sandstone, blue	987	"	1030
Blue lick water			987
Brown limestone	1030	"	1052
Water sandstone	1052	"	1077
Limestone	1077	"	1365
Shale	1365	"	1385
Shale	1385	"	1550
White shale	1550	"	1685
Black shale	1683	"	1791
Sandstone	1791	"	1836
Light showing of oil			1836
Sandstone and limestone	1836	"	1858
Sandstone, water sand	1836	"	1858
About the same to bottom of hole			1892

Pigg Drill East of Lewis, Indiana

	Feet		
Coal	75	to	80
Broken stuff, soft lime shale and a little broken sand			410
Water sand	410	"	615
Shale	615	"	695
Water sand	695	"	725
Black shale	725	"	730
Top of big lime			730
Hard lime	730	"	740
White shale	740	"	744
Hard lime	744	"	800

	Feet.		
Soft lime	800	"	805
Hard lime	805	"	950
Shale	950	"	955
Hard lime	955	"	1075
Blue sand	1075	"	1100
Water			1090
Lime	1100	"	1175
Brown sand	1175	"	1185
Lime	1185	"	1290
Sandy lime	1290	"	1300
Lime	1300	"	1420
Blue lime	1420	"	1500
Gray lime	1500	"	1525
Light shale	1525	"	1570
Dark shale	1570	"	1670
Light shale	1670	"	1680
Riley? sand	1680	"	1684
Light shale	1684	"	1785
Dark shale	1785	"	1860

It was drilled some deeper than this, but the record further down was unobtainable.

Merchon Well

Glacial drift	35	feet.
Sandstone and shale	35	"
Sandstone	5	"
Sandy shale	15	"
Slate and stone	6	"
Blue shale	20	"
Sandstone	3	"
Sandy shale and slate	16	"
Black sandstone	13	"
Gray slate	75	"
Sandstone	20	"
Stone and slate	10	"
Sandstone	30	"
Sandstone and slate	28	"
Gray slate	10	"
Sand and slate	17	"
Sandstone and slate	50	"
Limestone	83	"
Slate and sandstone	5	"
Limestone and slate	5	"
Limestone	30	"
Black slate	20	"
Blue slate	267	"
Slate	145	"
	979	"

	Measured Line 930		
Slate	70	feet	
Blue slate	48	"	
Blue shale	46	"	
Casing set	1094	"	
Blue shale	95	"	—1189
Black shale	19	"	—1208
Oil on water, salt water			
Limestone	34	"	
Total depth	1242	"	

The above is the record of a well drilled about 1⅛ miles Southwest of Carbon in the center of Section 12, T. 13 N, R. 7 W. Record secured by Dr. C. A. Malott.

CLINTON COUNTY

With the exception of a small area in the southwestern part of the county which is occupied by strata of the Mississippian age, the entire subsurface of this county is occupied by Devonian strata. The glacial drift overlying the bed rock varies in thickness from 50 to 300 feet. This covering prevents the determination of the structural conditions of the durolith.

The following are the records of two wells drilled at Frankfort.[3]

Section of Well No. 1

Drift	88	feet.
Niagara limestone and shale	272	"
Hudson River and Utica	480	"
Trenton limestone	22	"
Total	862	"

Yielded good flow of gas.

Section of Well No. 2

Drift	278	feet.
Niagara limestone and shale	380	"
Limestone	10	"
Hudson River and Utica	400	"
Trenton limestone	260	"
Total depth	1328	"
Trenton below sea level	327	"

Yielded no gas.

Railroad Elevations

Forest, 878.8; Frankfort, 846.7; Colfax, 840.7; Moran, 796.7; Michigantown, 866.2; Jefferson, 859.3; Manson, 857.7; Sedalia, 776.7; Avery, 872; Fickle, 827.3; Kilmore, 829.7; Circleville, 929.3; Hillsburg, 919.7; Boylston, 903.0; Deniston, 844.1; Mulberry, 772.6.

CRAWFORD COUNTY

Crawford County lies within the driftless area of Indiana. The strata which outcrop in the county belong to the following divisions and subdivisions:

Quaternary	Recent—alluvium.
	Pleistocene—residuals.
Pennsylvanian	Allegheny—shales, sandstones, limestones, coal.
	Pottsville—sandstones, shales and coal.
Mississippian	Chester—shale, sandstone and limestone.
	Mitchell—limestone.

The structural conditions for a portion of the county can probably be determined by using limestones as the key formations. A portion of Orange County has already been mapped structurally and since the geological conditions are similar, for a part of Crawford County, it may be that the work can be extended to the latter. Possible oil bearing sand may be expected in the Trenton, Devonian and Chester rocks.

Taswell Well.

In 1903 the Highland Investment Company of Chicago, drilled a well in search of gas or oil, near the eastern limits of Taswell, eight miles east of Birdseye, on the Southern Railway. Drilling continued to a depth of 1,690 feet, where they encountered the actual Trenton, and drilled it 100 feet, a total depth of 1,790 feet, and got neither gas nor oil. In the western part of Crawford County there are surface indications of oil that have an extent of five miles in width by ten miles in length. Oil in paying quantities was never found. An oil well and a gas well were drilled in Section 16, Patoka Township about one mile northwest of Eckerty.

DAVIESS COUNTY

The mantle of glacial drift varies in thickness in this county from a few feet to more than one hundred feet in the valley of White River. The strata which underlie the drift belong to the Pennsylvanian period. Outcrops of the Pottsville division occur in the east part of the county and of Allegheny in the western portion. Structural conditions of the bed rock cannot be determined by surficial observation so that subsurface work must be resorted to in order to achieve results. Oil has been found in this county south of Cannelburg in Barr Township in the southeast part of Section 8. One dry hole was drilled in the north; one dry hole in Section 7; one gas well and one dry hole in Section 3; one oil well and one gas well in the northwest quarter of Section 17, and one oil well in Section 30. The productive wells range in depth from 380 feet to 725 feet. The oil sand probably occurs in the Mansfield and the Chester.

Washington Township. In Section 22 of this Township, on the land of Stanton Barber, a well was drilled and plugged in 1912.

Madison Township. A well was drilled on the land of the Graham Class Company in Section 34. The well was plugged in 1912.

Reeves Township. A well was drilled on the property of D. A. Brown in Section 10 and plugged in 1910.

Barr Township. The following wells have been plugged in this Township: Section 2, Ralph Thompson, 1911. Section 35, Ed Grundy, 1911, and Charles M. Allan in 1913.

Harrison Township. A well drilled in Section 32 on the James Pettigrew property was plugged in 1911 and one in the same section on the property of F. M. Remsel in 1912.

The majority of the wells drilled in this County were drilled from 1910 to 1912.

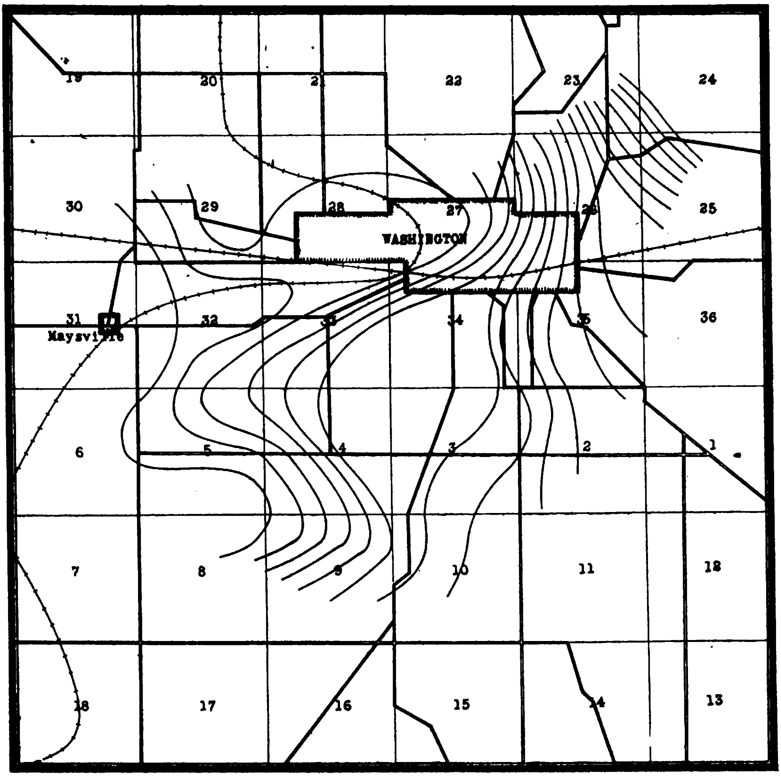

Fig. 31. Structural map of an area near Washinton, Daviess County. Contours drawn on Coal VII. Data secured by C. A. Malott and P. B. Stockdale of the field party of 1919.

DEARBORN COUNTY

The bedrock formations of this county belong to the Ordovician period of geologic time. They are for the most part covered with glacial drift.

It may be possible to determine the structural conditions of this County if enough outcrops and well records can be secured. It lies on the west side of the Cincinnati Arch and the surface of the Trenton may be low enough in the southwest part of the County to be favorable territory. The surface of the Trenton is 158 feet above sea level at Lawrenceburg, where gas was obtained and dips westward where at North Vernon it is 260 feet below sea level.

Lawrenceburg Township. The log of a well drilled at Lawrenceburg in the river valley is as follows:

Alluvium	139	feet.
Hudson River limestone and shale	185	"
Utica shale	25	"
Trenton limestone	451	"
Potsdam sandstone	40	"
Total depth	840	"
Trenton above sea level	158	"

The second well was drilled in the fairgrounds and reached the Trenton at 325 feet and showed gas.

Center Township. A well drilled at Aurora has the following log:

Drift	92	feet.
Bluish green shale	148	"
Dark shale, Utica	25	"
Limestone, Utica, gas	2	"
Shales and limestone, Utica	18	"
Shale, Utica	25	"
Trenton limestone	521	"
St. Peter	about 170	"
Total depth	1000	"
Altitude of well	472	"

DECATUR COUNTY

The bed rock formations of this county are of Silurian and Devonian age and are largely concealed by glacial drift which varies in thickness from 10 to 100 feet.

Washington Township. The record of the Greensburg city well as given by Phinney is as follows:

	City Well	No. 1	No. 2	No. 3
Drift	10	7	......	......
Corniferous limestone	4	90	......	......
Niagara limestone	66	90	......	......
Niagara shale	35	......	......	......
Hudson River & Utica shale	747	823	886	883
Trenton	......	63	......	......
Total	862	983	886	883
Altitude of well	930	920	925	925

The following wells have been abandoned:

Owner	Section	Date	Wells
Township School	2	1911	1
Aaron Logan	3	1919	1
Wm. Jackson	4	1919	1
City of Greensburg	5	1911	1
S. Logan	10	1919	1

Adams Township. A well drilled on the Chas. White property was abandoned in 1911.

The surface of the Trenton around Greensburg varies from sea level to 68 feet above sea level. The gas obtained in the wells at Greensburg had a maximum pressure of 350 pounds. In the northwestern portions of the County in Adams Township, at Adams and St. Omer, light flows of gas were obtained.

DeKALB COUNTY

The subsurface of this county is occupied by strata of the Devonian age which in the region of Auburn seems to have been slightly uplifted. The surface of the eroded Devonian rocks are covered with glacial drift which attains a thickness of more than 300 feet. Deep wells have been drilled at Auburn, Butler, Garrett and Waterloo. The structural conditions of the durolith are determinable only by the use of subsurface data.

The record of one of Auburn wells follows:

Section of Well No. 1

Drift	280	feet.
Black shale	120	"
Corniferous, water-lime and Niagara	963	"
Hudson River, limestone and shale	306	"
Utica shale	268	"
Trenton limestone	27	"
Total depth	1964	"

The following is the log of the Butler well:

Section of Well No. 1

Drift	378	feet.
Hamilton shale	108	feet.
Corniferous, water-lime and Niagara	1064	"
Hudson River and Utica	500	"
Trenton limestone	89	"
Total depth	2139	"

Yielded a small flow of gas, which was found at a depth of 27 feet in the Trenton.

The record of the well at Garrett is given below:

Section of Well No. 1

Depth to Trenton	1980 feet.
Total depth	2160 "
Trenton below sea level	1098 "

Yielded a small flow of gas.

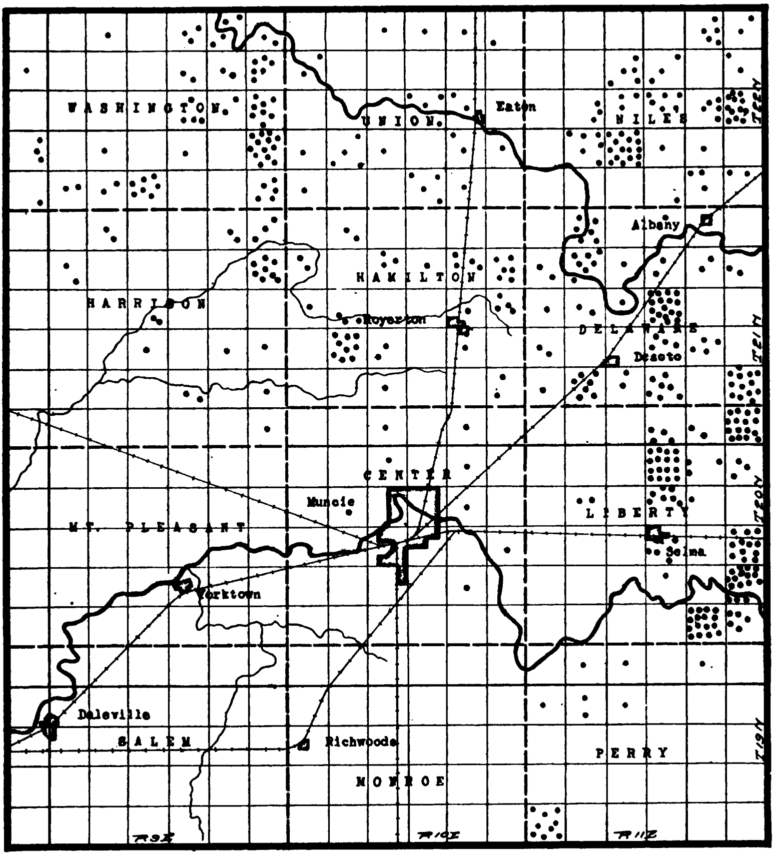

Fig. 32. Map of Delaware County showing location of abandoned wells. The eastern tier of townships are oil bearing, the remainder of the county is gas territory.

DELAWARE COUNTY

The Niagara limestone occupies the subsurface of this county and is covered with a mantle of glacial drift varying in thickness from 50 to 150 feet. A large number of wells have been drilled in this county and nearly 1,500 have been abandoned. From 1906 to 1914, 422 wells were completed, 103 of which were dry.

Centre Township. Many productive gas wells have been drilled at and near Muncie. The combined records of wells No. 1 and No. 2, are given by Phinney as follows:

Cedarville limestone	90 feet.
Bluish limestone (Springfield beds)	135 "
Niagara shale	40 "
Hudson River limestone and shale	100 "
Hudson River shale	340 "
Utica shale	270 "
Trenton limestone	481 "
St. Peter's sandstone	150 "
Total depth	1606 "

The records of other wells are given in the table below:

Well	Altitude	Depth to Trenton	Altitude of Trenton
Nut Gas Co., No. 1	936	876	60
Nut Gas Co., No. 2	933	889	44
Reid Well	955	887	68
Highland	949	884	65
Bent Works	946	894	52
West Main St.	930	872	58
Fay	938	887	51
Winton	936	892	44
Water Works	938	891	47
Anthony	956	891	65
Boycetown No. 1	944	886	58

Two wells were drilled on the J. C. Quick farm in Section 14, one yielded 25 barrel of oil. The records are as follows:

	No. 1	No. 2
Drive pipe	104	108
Casing	348	350
Top of Trenton	898	890
Total Depth	1212	1210

In Section 35 a million-foot gas well has the following record:

Drive pipe	47 feet.
Casing	350 "
Top of Trenton	920 "
Total depth	1015 "

Abandoned wells are located in the following sections: Section 2, 1 well; Section 4, 1 well; Section 8, 1 well; Section 11, 1 well; Section 13, 1 well; Section 23, 1 well; Section 33, 1 well; Section 34, 1 well.

Delaware Township. A gas well at Albany furnished the following record:

Drift	8 feet.
Limestone	200 "
Shale (Niagara)	68 "
Hudson River and Utica shale	658 "
Black shaly limestone	30 "
Trenton limestone	14 "
Total depth	978 "
Altitude of well	940 "

The table below gives the records of various wells drilled in this Township.

	Section 16			Sec. 18	Sec. 15	Sec. 10
Drive pipe	80	70	70	28	40	27
Casing	380	370	370	294	370	310
Top of Trenton	940	960	965	921	920	921
Total depth	1280	1290	1297	1227	1195	1232

Wells abandoned are located in Section 3, 1 well; Section 5, 6 wells; Section 7, 2 wells; Section 8, 7 wells; Section 9, 1 well; Section 10, 2 wells; Section 11, 2 wells; Section 12, 2 wells; Section 15, 19 wells; Section 16, 1 well; Section 17, 2 wells; Section 18, 1 well; Section 19, 2 wells; Section 22, 4 wells; Section 23, 4 wells; Section 25, 13 wells; Section 27, 7 wells; Section 28, 2 wells; Section 29, 7 wells; Section 30, 1 well; Section 36, 5 wells.

Liberty Township. The record of well drilled in this township is as follows:

Drift	90 feet.
White and buff limestone	85 "
Soft and Ferruginous	15 "
Bluish limestone	75 "
Niagara shale	40 "
Hudson River	485 "
Utica shale	210 "
Trenton limestone	25 "
Total depth	1025 "
Altitude of well	1015 "

As late as 1903, 81 wells were drilled in this Township. Fifty-three produced oil and the average initial production was 21 barrels. The records of three wells as given by Blatchley are as follows:

	Section 12	Section 14	
Drive pipe	85 feet	104	97
Casing	360 feet	350	364
Top of Trenton	976 feet	984	988
Total depth	1030 feet	1040	1035

Wells abandoned are located as follows: Section 1, 3 wells; Section 2, 3 wells; Section 3, 16 wells; Section 10, 7 wells; Section 13, 12 wells; Section 14, 1 well; Section 15, 4 wells; Section 17, 2 wells; Section 22, 1 well; Section 24, 26 wells; Section 25, 5 wells; Section 26, 16 wells; Section 34, 4 wells; Section 35, 2 wells; Section 36, 22 wells.

Union Township. A well drilled in Eaton in 1876 produced some gas from Hudson River Shale. In September, 1886, the first gas well of importance in Indiana was drilled at this place. The record of the well follows:

Buff limestone	5	feet.
Bluish limestone	20	"
Buff limestone	30	"
Bluish gray limestone	45	"
White limestone	35	"
Shale, bluish green	35	"
Buff limestone (Clinton)	10	"
Shale, Hudson River and Utica	690	"
Trenton limestone	32	"
Total depth	922	"

The Trenton was reached at Shideler at 884 feet. Successful gas wells were drilled at Cowan, Oakville, Yorktown, Royerton and New Corner.

Jas. Dill Farm, Section 26, Township 21 North Range 11 East.

Top soil	67	feet.
Lime	200	"
Shales	681	"
Top of sand	948	"
Into Trenton	325	"
Salt water struck in Trenton	320	"

Jefferson Township. An abandoned well is located in Section 21.

Harrison Township. Abandoned wells are located as follows: Section 1, 3 wells; Section 2, 2 wells; Section 5, 2 wells; Section 7, 2 wells; Section 12, 8 wells; Section 16, 2 wells; Section 21, 1 well; Section 23, 1 well; Section 24, 1 well; Section 25, 1 well; Section 27, 2 wells; Section 36, 1 well.

Hamilton Township. Wells were drilled in the following sections: Section 5, 2 wells; Section 7, 2 wells; Section 10, 1 well; Section 11, 4 wells; Section 12, 6 wells; Section 13, 4 wells; Section 16, 2 wells; Section 17, 3 wells; Section 20, 9 wells; Section 21, 2 wells; Section 23, 2 wells; Section 24, 1 well; Section 25, 9 wells; Section 28, 1 well; Section 30, 1 well.

Washington Township. Wells were drilled and abandoned as follows: Section 5, 1 well; Section 10, 2 wells; Section 11, 2 wells; Section 12, 1 well; Section 13, 4 wells; Section 14, 1 well; Section 15, 1 well; Section 22, 2 wells; Section 23, 1 well; Section 24, 4 wells; Section 25, 8 wells; Section 27, 1 well; Section 31, 1 well; Section 32, 1 well; Section 33, 4 wells; Section 36, 3 wells.

Niles Township. Wells abandoned are as follows: One each in Sections 11, 12, 20, 23, 13, 26, 27, 34, 35 and 36; Section 9, 2 wells; Section 21, 3 wells; Section 22, 5 wells; Section 24, 5 wells; Section 28, 13 wells; Section 15, 2 wells; Section 16, 4 wells and Section 29, 4 wells.

Union Township. Wells abandoned are located as follows: One each in Sections 9, 10, 11, 12, 18, 25, 27 and 35; 2 in Section 20; 4 in Section 22; 2 in Section 26; 3 in Section 28; 2 in Section 29 and 4 in Section 34.

Perry Township. Abandoned wells are located one each in Sections 2, 4, 7, 9, and 3 in Section 5; 2 in Section 8, and 11 in Section 34.

Wells drilled by Wallace Oil Company, Section 22, Delaware Township, Farm of Marcellius Hitchcock.

Well No. 1

8″ drive pipe	30	feet.
6¼″ casing	326	"
Top Trenton	935	"
Oil (light showing)	1206	"
Total depth	1209	"

Shot March 25, 1919. Well pumping.

Well No. 2

8″ drive pipe	18	feet.
6¼″ casing	306	"
Top Trenton	926	"
Crevice showing light gas	1184	"
Total depth	1187	"

Well No. 3

10″ drive pipe	28	feet.
8″ drive pipe	140	"
6¼″ casing	330	"
Top Trenton	940	"
Oil	1215	"
Total depth	1216	"

Light oil. Well pumping light.

Well No. 4

10″ drive pipe	45	feet.
8″ drive pipe	96	"
6⅝″ casing	330	"
Top Trenton	946	"
Oil (first)	1220-32	"
Total depth	1232	"

Light oil.

Well No. 5

10″ drive pipe	57	feet.
8″ drive pipe	89	"
6⅝″ Casing	315	"
Top Trenton	945	"
Total depth	1208	"

Light oil.

Well No. 1. Farm of Willis Workwell

8¼″ drive pipe	37 feet.
6¼″ casing	332 "
Top of Trenton	935 "
Oil	1210 "
Total depth	1213⅛ "

Light oil.

Well No. 2

10″ drive pipe	20 feet.
8″ drive pipe	100 "
6⅝″ casing	332 "
Total depth	1206 "
First pay	1200 "

Light showing. Well pumping.

Farm of Elmer Ritchie. Well No. 1

10″ drive pipe	39 feet.
8″ drive pipe	95 "
6¼″ casing	295 "
Top Trenton	927 "
Total depth	1206 "
First oil	1198 "
Best oil	1203 "

Well No. 2

8″ drive pipe	76 feet.
6¼″ casing	309 "
Top Trenton	927 "
Total depth, 1207–oil	1200 "

Monarch Gas Company, Winchester, Indiana, Well No. 1

S. W. corner of E, ½ of S. W. ¼ of Sec. Delaware Township 21, Range 11. 125 feet drive pipe.

Drive pipe	125 feet.
Casing	325 "
To sand	900 "
In sand	320 "
Depth of well	1230 "

Well No. 2

500 feet W. and 500 feet N. of S. E. corner of W. ½ of S. W. ¼ of Sec. Delaware Township 21, Range 11.

Drive pipe	69 feet, 1 inch.
Casing	335 "
To sand	916 "
Depth of well	1210 "

Well No. 3

650 feet West and 1,000 feet N. of S. E. corner of W. ½ of S. W. ¼ of Sec. Delaware Township 21, Range 11.

Drive pipe	79 feet.
Casing	340 "
To sand	915 "
In sand	288 "
Depth of well	1202 "

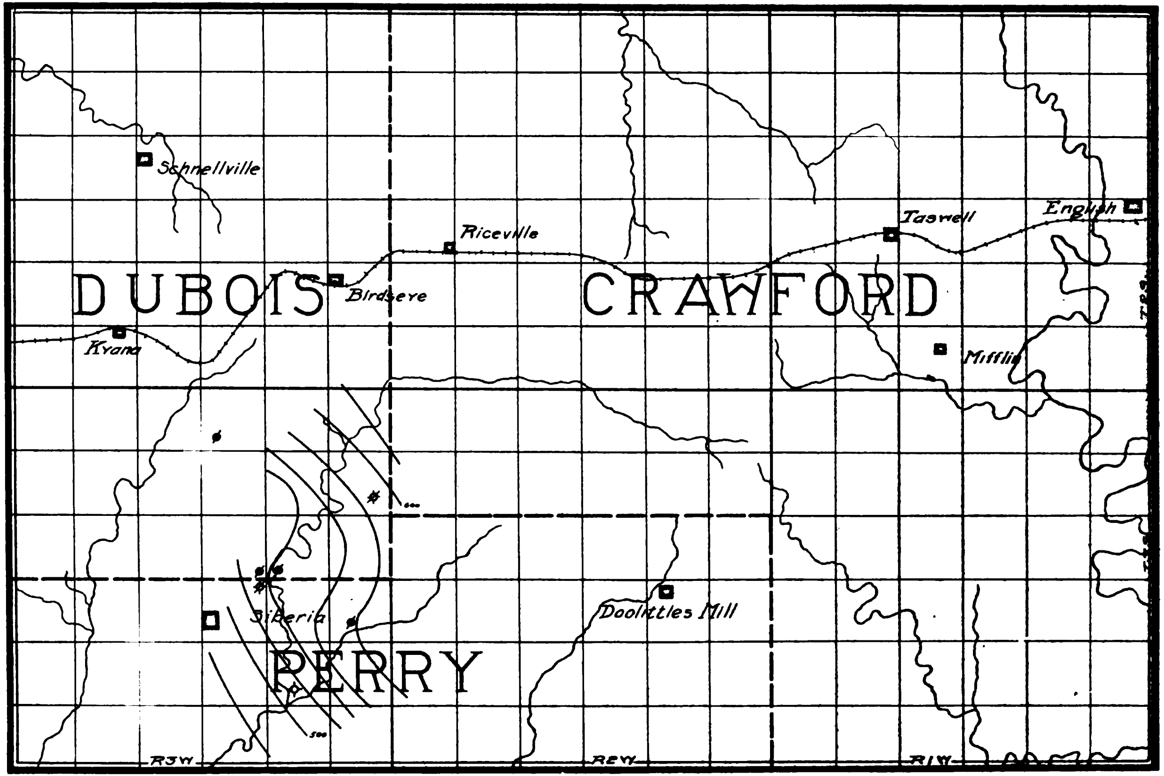

Fig. 33. Map of the Siberia oil field Dubois and Perry counties showing a few contours drawn on Siberia limestone (Minard?) by C. A. Malott.

DUBOIS COUNTY

Only the northwestern part of this county lies within the glaciated area The larger part of its surface is occupied by the outcrops of the strata of the Coal Measures. The divisions and the subdivisions represented by outcrops in the county are given below:

Quaternary	Recent—Alluvium. Pleistocene—Clays, sands and gravels.
Pennsylvanian	Allegheny—Sandstone, limestone shale, coal. Pottsville—Sandstone, shale and coal.
Mississippian	Chester—Shales, limestone and sandstones.

Structural conditions will be difficult to determine in this county because of the absence over a large part of the County of persistent layers which may be used as key horizons. In limited areas it may be possible to use some of the coal beds and in limited areas in the southeastern and the northeastern parts of the county to use some of the limestones of the Chester as key horizons.

Birdseye. A small oil and gas field has been developed about Birdseye. Fourteen wells were drilled in Dubois, Crawford and Perry, oil was obtained in ten, gas in one and three were nonproductive. The depth of the oil bearing sand varied in the various wells from 980 feet to 1,010 feet. The oil sand is probably in the Devonian limestone and occurs about ten feet below the top of the limestone. A black or brownish black shale forty feet thick overlies the limestone.

Patoka Township. A well drilled on the property of J. E. Shertz and Company in Section 36 was plugged in 1911.

About ten wells have been drilled in the county, five of which were dry.

ELKHART COUNTY

Glacial drift covers the bed rock in this county to a depth of from 50 to 200 feet. The drift overlies the eroded surface of the Devonian and Mississippian strata which dip northward.

Structural conditions of the durolith cannot be determined by direct observation because the outcrop of the durolith is concealed by the drift. Subsurface work is prevented by the absence of sufficient well records.

The record of a well drilled at Elkhart is as follows:[1]

Section of Well No. 1

Drift	122 feet.
Subcarboniferous shale (gray shale)	213 "
Hamilton black shale	215 "
Corniferous limestone	65 "

"At this depth the well was abandoned under the erroneous belief that the drill had passed through the Hudson River and the Utica shales, and that the Corniferous was Trenton limestone."

The record of a well drilled at Goshen is as follows:

Section of Well No. 2

Drift	165	feet.
Shale, sub-carboniferous and Devonian	308	"
Corniferous limestone	60	"
Water lime	32	"
Niagara limestone	728	"
Hudson River limestone and shale	307	"
Utica shale	215	"
Trenton limestone	239	"
Total depth	2054	"
Trenton below sea level	1026	"

Yielded no gas.

Railroad Elevations

Elkhart, 753.0; Dunlap, 784.5; Goshen, 797.6; Millersburg, 879.7; Morehouse, 761.4; Bristol, 771.8; Vistula, 794.2; Williams, 845.5; Burns, 894.6; Middlebury, 852.1; Pleasant Valley, 749.9; New Paris, 809.

FAYETTE COUNTY

The Pleistocene deposits in this county range in thickness from 25 feet to more than 100 feet. The strata underlying the Pleistocene belong to the Silurian and Devonian periods. The outcrops of these rocks being concealed by the glacial drift, the determination of the structural conditions favorable to the accumulation of oil and gas is difficult. The surface of the Trenton limestone for the greater part if not all of this County lies above sea level and lies 700 to 900 feet below the surface. At Connersyille the following well records were obtained:[2]

Section of Well No. 1

Drift, Hudson River and Utica	712	feet.
Trenton limestone	522	"
Potsdam sandstone	12	"
Total depth	1246	"
Trenton above sea level	120	"

Yielded a small flow of gas.

Section of Well No. 2

Drift	90	feet.
Hudson River and Utica	615	"
Trenton limestone	61	"
Total depth	766	"
Trenton above sea level	117	"

Yielded a small flow of gas.

Harrison Township. A deep well was drilled on the W. H. Wolt property in Section 8 and abandoned in 1912.

Posey Township. A well was drilled on the John Copeland property in Section 3, and abandoned in 1911. Another well was drilled on the property of J. Lambertson in Section 10 and abandoned in 1912.

Gas was obtained in Connersville, Jackson and Posey Townships.

FLOYD COUNTY

Floyd County lies in the unglaciated area of Indiana. The strata which outcrop in the county belong to the Devonian, Mississippian and Quaternary periods. The sub-divisions present are represented in the following table:

Quaternary	Recent—Alluvium. Pleistocene—Residuals.
Mississippian	Mitchell limestone. Salem limestone. Harrodsburg limestone. Knobstone, shales and sandstones. Rockford limestones.
Devonian	New Albany—Shale. Sellersburg—Limestone.

By using the contact of the Knobstone and the Harrodsburg it may be possible to determine the structural conditions of a part of this County. The contact of the New Albany and the Rockford might also be used as a key horizon.

The following is the record of a well drilled at New Albany:

Section of Well No. 1[2].

Clay and sub-carboniferous shale	80	feet.
Devonian shale	104	"
Corniferous limestone	69	"
Niagara limestone	209	"
Hudson River and Utica	545	"
Trenton limestone	500	"
Total depth	1507	"

Yielded no gas or oil.

Railroad Elevations

New Albany, 498.8; Smith, 565; Floyd, 445.8; Georgetown, 710.

FOUNTAIN COUNTY

Underlying the glacial drift of this County are strata belonging to the Knobstone, Warsaw, Salem and Chester (?) divisions of the Mississippian and to the Pottsville and the Allegheny divisions of the Pennsylvanian periods. The glacial drift which largely conceals these formations varies

in thickness from a few feet to more than one hundred feet. Whether or not structural conditions favorable to the accumulation of oil and gas exist in this County, can be determined only from subsurface data. Surficial methods cannot be used because of the glacial covering which conceals the outcrops. From reliable data collected in the form of well, shaft and outcrop records, it may be possible to determine the structural conditions.

Van Buren Township. Near Veedersburg three wells were drilled to depths of 1,000 feet. In one of them, gas occurred at 610 feet. These wells probably finished in the Devonian.

Two wells were drilled six miles south of Veedersburg to depths of 900 feet.

Cain Township. A well was drilled by the Fountain County Oil and Gas Company, 4½ miles southwest of Hillsboro. The log of the well follows:

Well No. 1

Drilling log of the David Keller well.

Yellow clay and gravel	0 to	30	feet.
Sand white	30 "	75	"
Shale gray	75 "	118	"
Sand white	118 "	220	"
Sand, limey, coarse	220 "	265	"
Sand, showing oil	265 "	273	"
Sand, limey, coarse	273 "	290	"
Sand, very light lime	290 "	305	"
Lime, very coarse	305 "	315	"
Shale, gray	315 "	350	"
Sand	350 "	400	"
Slate, white	400 "	415	"
Lime, hard, coarse	415 "	430	"
Shale, gray	430 "	545	"
Lime, hard, coarse	545 "	550	"
Shale, gray	550 "	565	"
Lime, blue, soft	565 "	595	"
Lime, hard	595 "	635	"
Shale, gray	635 "	685	"
Clay, green	685 "	725	"
Slate, white	725 "	735	"
Shale, black	735 "	755	"
Shale, brown	755 "	800	"
Slate, white	800 "	810	"
Shale, brown	810 "	840	"
Sand, hard, brown	840 "	860	"
Sand, odor of oil	860 "	890	"
Niagara lime, containing salt water	890 "	938	"

Railroad Elevations

Mellott, 699.0; Veedersburg, 604.3; Cates, 644.7; Silverwood, 516.0; Attica, 543.0; Rob Roy, 634.0; Aylesworth, 635.0; Stone Bluff, 622.0.

FRANKLIN COUNTY

The subsurface formations of this county belong to the Ordovician and the Silurian periods. They are covered largely by a mantle of glacial drift.

The divisions which are probably represented in the durolith are as follows:

Silurian	Louisville limestone. Waldron shale. Laurel limestone. Osgood limestone and shale. Brassfield.
Ordovician	Richmond, shales and limestones. Maysville shales, limestone and sandstones. Eden, shales, limestones and sandstones. Trenton limestones. St. Peter's sandstone.

Brookville Township. Seven wells were drilled in the vicinity of Brookville. The log of a well drilled in White Water River valley is as follows:

Drift	157 feet.
Shale	243 "
Trenton and St. Peter	854 "
Total depth	1254 "
Altitude of well	575 "
Salt water at	800 "

Well, No. 2, located in town reached the Trenton at 550 feet at an altitude of 700 feet. The surface of the Trenton is 150 feet above sea level. A small supply of gas was obtained in this township and in Laurel Township.

Railroad Elevations

Peoria, 999; Raymond, 1,008; Bath, 1,012.

FULTON COUNTY

Strata belonging to the Silurian and Devonian periods lie beneath the glacial drift in this County. The drift attains a thickness of more than 300 feet.

The concealment of the strata of the durolith by the drift makes it impossible to determine the structural conditions by surficial methods. The accumulation of the logs of deep wells will greatly aid in such determination. The County lies on the north slope of the Cincinnati Arch and the Trenton surface which lies nearest sea level near the southern boundary of the County is 351 feet below sea level at Rochester.

The section of a well drilled at Rochester is given below:[3]

Section of Well No. 1

Drift	245 feet.
Niagara limestone	525 "
Hudson River and Utica	391 "
Trenton limestone	24 "
Total depth	1185 "
Trenton below sea level	351 "

Yielded no gas.

Record of well drilled at Kewana:[3]

Section of Well No. 1

Drift	170 feet.
Limestone and shale	879 "
Trenton limestone	29 "
Total depth	1078 "
Trenton below sea level	278 "

Did not yield gas or oil.

GIBSON COUNTY

The strata underlying the glacial drift in Gibson County are the coal measures of the Pennsylvanian period. The mantle of drift has been removed in places so that the outcrops of the bed rock occur in the northern and central parts of the County. The extreme southern part of the County was not glaciated. The structural conditions of the bed rock can not be determined from a study of surficial conditions. However the use of the subsurface data combined with such surficial data as may be obtained from outcrops, may make it possible to locate structures favorable to the accumulation of oil and gas. Several small oil pools have been located in this County but largely, if not wholly, by using the drill. The position of these pools is given in the accompanying map. There are probably three sands in this County from which oil has been obtained. These sands probably all belong to the Pennsylvanian group of rocks or possibly the lower to the Chester.

White River Township. Eight miles northwest of Princeton, gas was obtained at 1,300 feet. At Hazelton three wells were drilled to 2,000 feet. Oil was obtained and this is known as the Hazelton pool.

Patoka Township. Wells in Sections 2, 9, 10 and 32, oil was obtained in 2 at 871 feet in the Princeton sand.

Center Township. S. E. ¼ of the S. W. ¼ of Section 36, bore drilled came in dry. (Rept. 1908) Oil is reported in a well drilled near Francisco to a depth of 1,690 feet.

One well in Oakland City[3] field, S. W. ¼ of the N. W. ¼ of Section 13, was reported to have reached a sand lower than the Oakland City sand

and to yield an oil of good gravity and of strong sulphur smell. The Oakland City sand in this well was found at 1,228 feet and was eight feet thick. The two lenses yielded an initial output of 150 barrels. The stray sand was found at a lower depth at 1,284 feet and was reported to be 18 feet thick, yielding the sulphur oil.

The No. 1 well on the Montgomery lease, completed in 1907, drilled to a depth of 1,000 feet, sand struck at 845 feet, 87 feet of drive pipe used; dry well. No. 17, drilled to a total depth of 862 feet, sand at 820 feet, drive pipe, eighty feet ten inches; sixty-five barrel well, completed March, 1907. No. 18, completed April, 1907, total depth, 865 feet; sand at 820 feet; 90 feet of drive pipe; 92 barrel well.

Well drilled on the Skinner farm, near Oakland City, total depth 1,300 feet; encountered salt water, dry well.

H. A. Mauck lease, S. W. ¼ of Section 19; drive pipe (10 inch) 95 feet; casing (8 inch), 130 feet; casing (6¼ inch) 785 feet; top of sand 918 feet.

Record of a well drilled in Washington Township. L. C. Frederick farm, No. 4.

		Depth	
Surface	30	30	
Sand	20	50	
Shale	20	70	
Broken sand	80	150	Cased with 10"
Black slate	50	200	
Sand, dry	60	260	
Shale	40	300	
Broken sand	20	320	Some water
Black slate	50	370	
Shale	30	400	
Lime shell	10	410	
Shale	90	500	
Black slate	30	530	
Shale	70	600	
Broken lime	20	620	Some water
Black slate	40	660	
Hard lime	10	670	
Coal	2	672	2' coal
Shale	50	722	
Sand	30	752	
Black slate	50	802	
Shale	40	842	
Black slate	20	862	
Sandy shale	60	922	
Black slate	40	962	
Lime	10	970	
Shale	35	1007	
Sand	20	1027	
Shale	5	1032	
Sandy lime	5	1037	
Oil sand	6	1041	
Total depth	....	1043	

Washington Township, well of McNeece, 2 miles east of Hazelton.

Lime and slate	600	to	700	feet.
Sand (dry)	700	"	710	"
Slate	710	"	780	"
Sand (4 Bailer water)	780	"	830	"
Slate	830	"	850	"
Broken sand (dry)	850	"	894	"
Slate	894	"	920	"
Sand (soft) strong flow water	920	"	975	"
Sand (no water)	975	"	980	"
Slate	980	"	1050	"
Sand (dry)	1050	"	1080	"
Slate	1080	"	1170	"
Lime rock	1170	"	1190	"
Slate	1190	"	1228	"
Slate	1228	"	1248	"
Lime rock	1248	"	1295	"
Slate	1295	"	1325	"
Lime rock	1325	"	1327	"
Slate and shell	1327	"	1335	"
White sand	1335	"	1340	"
Slate	1340	"	1405	"
Lime rock	1405	"	1420	"
Broken sand and shale	1420	"	1450	"
Sand (strong flow of water)	1450	"	1500	"
Lime rock	1500	"	1520	"
Slate	1520	"	1525	"
Red rock	1525	"	1530	"
Lime rock	1530	"	1535	"
Slate	1535	"	1573	"
Lime rock	1573	"	1590	"
Slate	1590	"	1595	"
Sandy (dry)	1595	"	1605	"
Red rock	1605	"	1610	"
Lime rock	1610	"	1620	"
White sand	1620	"	1680	"
Lime rock	1680	"	1690	"
Slate	1690	"	1718	"
Lime rock	1718	"	1722	"
Sand (dry)	1722	"	1740	"
Lime rock	1740	"	1800	"
Oil sand (slight show)	1800	"	1806	"
Lime rock	1806	"	1870	"
Lime rock	1870	"	2000	"
Total depth			2000	feet.

Log of well No. 5 on the L. C. Frederick farm, Washington Township, Gibson County.

Surface	to	30	feet.
Sand	"	60	"

Fire clay	to	65	feet
Coal	"	68	"
Slate	"	80	"
Sand	"	125	"
Dark slate	"	160	"
Shale	"	195	"
Sand and water	"	220	"
Slate	"	235	"
Lime	"	245	"
Shale	"	285	"
Sand (dry)	"	295	"
Shale	"	320	"
Broken lime	"	335	"
Shale	"	355	"
Sand	"	365	"
Slate	"	370	"
Lime	"	378	"
Shale	"	420	"
Lime	"	425	"
Brown shale	"	440	"
Slate	"	465	"
Shale	"	493	"
Coal	"	504	"
Fire clay	"	508	"
Sand	"	515	"
Shale	"	555	"
Lime	"	562	"
Shale	"	590	"
Brown shale	"	620	"
Sandy lime	"	625	"
Brown shale	"	675	"
Broken lime	"	685	"
Slate	"	700	"
Lime	"	710	"
Sand	"	725	"
Slate	"	730	"
Sand	"	750	"
Sandy shale	"	800	"
Lime	"	810	"
Shale	"	825	"
Slate	"	875	"
Shale	"	900	"
Sand	"	920	"
Shale	"	950	"
Water sand	"	965	"
Shale	"	1005	"
Slate	"	1025	"
Broken sand	"	1065	"

Sand	to	1165	feet	
Shale	"	1185	"	
Lime	"	1195	"	
Slate	"	1220	"	
Lime	"	1225	"	
Slate	"	1235	"	
Lime shell	"	1240	"	
Slate	"	1245	"	
Shale	"	1260	"	
Lime	"	1270	"	
Broken sand	"	1280	"	Hoover
Hoover sand	"	1305	"	
Shale	"	1310	"	
Broken sand	"	1320	"	Gas sand
Sand, gas at 1328	"	1355	"	
Brake	"	1358	"	
Lime	"	1380	"	
Greene shale	"	1405	"	
Lime	"	1415	"	
Shale	"	1430	"	
Lime	"	1450	"	
Shale	"	1455	"	
Lime	"	1455	"	
Shale	"	1470	"	
Broken sand	"	1485	"	
Lime	"	1490	"	
Sand	"	1500	"	

Well No. 3 on the John Zimmerman farm; 200 feet to East line, 665 feet to South line. Section 7, Washington Township, Gibson County.

Soil	to	1	foot.
Dark clay	"	20	feet.
Gravel	"	22	"
Dark slate	"	40	"
Dark lime	"	44	"
Dark slate	"	98	"
Gray sand	"	114	"
Dark slate	"	157	"
Coal	"	161	"
Dark slate	"	179	"
Gray lime	"	185	"
Dark slate	"	186	"
Gray lime	"	191	"
Dark slate	"	194	"
Gray lime	"	200	"
Gray sand	"	209	"
Black slate	"	240	"
Light slate	"	245	"
Dark slate	"	300	"

Light sand	to 320	feet
Gray sand, water	" 365	"
Gray lime	" 369	"
Coal	" 372	"
Gray sand	" 386	"
Dark slate	" 421	"
Gray sand	" 431	"
Dark slate	" 480	"
Brown slate	" 490	"
Dark slate	" 525	"
Brown lime	" 535	"
Black slate	" 540	"
Gray lime	" 546	"
Gray sand	" 556	"
Light slate	" 566	"
Dark slate	" 578	"
Gray lime	" 583	"
Light slate	" 610	"
Coal	" 615	"
Dark slate	" 625	"
Gray lime	" 630	"
Black slate	" 760	"
Gray sand	" 775	"
Dark slate	" 815	"
Gray sand	" 825	"
Dark slate	" 830	"
Gray sand	" 850	"
Dark slate	" 865	"
Gray sand	" 895	"
Brown lime	" 900	"
Black slate	" 908	"
Gray lime	" 912	"
Black slate	" 925	"
Gray sand	" 939	"
Dark slate	" 1001	"
Black slate	" 1004	"
Dark slate	" 1016	"
Gray sand	" 1025	"
Dark slate	" 1030	"
Gray sand	" 1035	"
Dark slate	" 1070	"
Gray sand	" 1230	"
Dark slate	" 1245	"
Dark lime	" 1247	"
Light slate	" 1254	"
Gray sand	" 1258	"
Dark slate	" 1265	"
Gray sand, gas	" 1279	"
Dark slate	" 1295	"
Gray lime	" 1306	"

Dark slate	to	1317	feet
Gray sand, first oil	"	1335	"
Dark slate	"	1337	"
Gray lime	"	1339	"
Dark slate	"	1348	"

Well No. 4 on the John Zimmerman farm, 200 feet to East line, 200 feet to South line. Section 7, Washington Township, Gibson County.

Soil	to	1	foot.
Yellow clay	"	12	feet.
Light slate	"	54	"
Dark slate	"	73	"
Dark sand	"	83	"
Dark slate	"	108	"
Dark lime	"	110	"
Dark slate	"	113	"
Gray sand	"	124	"
Light slate	"	127	"
Gray lime	"	133	"
Dark slate	"	170	"
Coal	"	174	"
Dark slate	"	197	"
Gray lime	"	208	"
Light slate	"	225	"
Gray sand	"	233	"
Dark slate	"	294	"
Gray sand	"	303	"
Dark slate	"	311	"
Dark sand	"	314	"
Dark slate	"	325	"
Dark sand	"	358	"
Dark slate	"	360	"
Light sand	"	385	"
Black lime	"	392	"
Dark slate	"	397	"
Light slate	"	405	"
Light sand	"	414	"
Light slate	"	462	"
Dark slate	"	500	"
Black slate	"	506	"
Gray lime	"	510	"
Coal	"	512	"
Dark slate	"	526	"
Dark lime	"	528	"
Dark slate	"	536	"
Gray lime	"	540	"
Coal	"	547	"
Light slate	"	572	"
Light sand	"	578	"
Dark slate	"	605	"

Light slate	to	635	feet
Dark slate	"	650	"
Gray lime	"	655	"
Light slate	"	665	"
Dark slate	"	776	"
Gray lime	"	784	"
Light slate	"	797	"
Gray sand	"	808	"
Dark slate	"	838	"
Light sand	"	862	"
Brown lime	"	865	"
Light sand	"	872	"
Dark slate	"	874	"
Dark sand	"	910	"
Gray lime	"	917	"
Light slate	"	930	"
Dark slate	"	942	"
Light sand	"	950	"
Dark slate	"	955	"
Light sand	"	960	"
Dark slate	"	1012	"
Light sand	"	1020	"
Dark slate	"	1025	"
Gray sand	"	1033	"
Light sand	"	1042	"
Dark slate	"	1050	"
Gray lime	"	1052	"
Light slate	"	1112	"
Light sand	"	1160	"
Light slate	"	1175	"
Light sand	"	1212	"
Light slate	"	1217	"
Gray sand	"	1246	"
Dark slate	"	1250	"
Light slate	"	1271	"
Dark lime	"	1273	"
Dark slate	"	1280	"
Dark sand	"	1288	"
Dark slate	"	1290	"
Light sand	"	1295	"
Light slate	"	1299	"
Light sand	"	1303	"
Dark slate	"	1314	"
Gray sand	"	1316	"
Brown lime	"	1324	"
Dark slate	"	1336	"
Gray sand, first oil at 1338	"	1353	"
Dark slate	"	1361	"

Well No. 1, on the farm of Mary Shawhan, 200 feet to East line, 700 feet to South line. Section 1, Washington Township, Gibson County.

Yellow clay	to	42	feet.
Light slate	"	48	"
Gray lime	"	51	"
Light slate	"	60	"
Dark slate	"	68	"
Light slate	"	71	"
Light lime, water at 73 ft.	"	75	"
Light slate	"	100	"
Coal	"	104	"
Light slate	"	176	"
Dark lime	"	180	"
Light slate	"	223	"
Coal	"	225	"
Light slate	"	230	"
Light sand	"	240	"
Dark slate	"	254	"
Light sand	"	269	"
Gray lime	"	274	"
Light slate	"	276	"
Gray lime	"	279	"
Dark slate	"	305	"
Coal	"	309	"
Dark slate	"	417	"
Dark lime	"	423	"
Light slate	"	500	"
Dark slate	"	520	"
Dark slate	"	545	"
Light slate	"	555	"
Dark slate	"	588	"
Light slate	"	602	"
Dark slate	"	615	"
Light slate	"	630	"
Dark lime	"	632	"
Dark slate	"	650	"
Light slate	"	662	"
Dark slate	"	750	"
Light slate	"	770	"
Dark slate	"	775	"
Light sand	"	780	"
Dark slate	"	787	"
Gray lime	"	790	"
Dark slate	"	835	"
Gray lime	"	839	"
Dark slate	"	898	"
Light lime	"	901	"
Dark slate	"	940	"
Gray lime	"	948	"

Dark slate	to 980 feet		
Light lime	" 1015	"	
Dark slate	" 1045	"	
Gray sand	" 1075	"	
Light sand	" 1103	"	
Dark slate	" 1114	"	
Light sand	" 1151	"	
Dark slate	" 1158	"	
Gray sand	" 1195	"	
Dark slate	" 1200	"	
Gray sand	" 1216	"	
Dark slate	" 1218	"	
Light sand	" 1294	"	
Dark slate	" 1300	"	
Brown lime	" 1301	"	
Dark slate	" 1338	"	
Gray sand	" 1343	"	
Dark slate	" 1350	"	
Gray lime	" 1373	"	shows gas
Dark slate	" 1384	"	
Gray sand	" 1390	"	barren
Dark slate	" 1393	"	
Gray lime	" 1400	"	
Light slate	" 1402	"	
Gray lime	" 1410	"	
Dark slate	" 1423	"	
Gray lime	" 1424	"	
Gray sand	" 1430	"	gas sand
White sand, hole full of water at 1436	" 1490	"	
Gray lime	" 1498	"	
Dark slate	" 1504	"	
Gray lime	" 1506	"	
Dark slate	" 1512	"	
Dark lime	" 1529	"	
Dark slate	" 1531	"	
Light sand	" 1533	"	
Light sand	" 1537	"	
Gray lime	" 1539	"	
Light sand	" 1550	"	
Dark slate	" 1560	"	
Brown lime	" 1569	"	
Dark slate	" 1572	"	
Gray sand	" 1584	"	
Light sand	" 1589	"	
Dark sand	" 1594	"	
Light sand	" 1601	"	
Light sand	" 1612	"	
Dark slate	" 1617	"	

Well No. 1, farm of Geo. Colvin, 164 feet to South line, 237 feet to West line. Section 6, Washington Township, Gibson County.

Yellow clay	to	35	feet.
Light slate	"	45	"
Gray lime	"	49	"
Dark slate	"	80	"
Light lime	"	100	"
Light sand	"	145	"
Dark slate	"	200	"
Gray lime	"	230	"
Light slate	"	235	"
Light lime	"	275	"
Dark slate	"	285	"
Light sand	"	292	"
Dark slate	"	295	"
Light sand	"	300	"
Dark slate	"	340	"
Light lime	"	350	"
Gray sand	"	380	"
Light slate	"	382	"
Gray slate	"	395	"
Light slate	"	397	"
Gray lime	"	400	"
Light slate	"	408	"
Gray lime	"	418	"
Light sand	"	425	"
Dark slate	"	475	"
Coal	"	480	"
Light slate	"	530	"
Coal	"	533	"
Gray lime	"	535	"
Dark slate	"	570	"
Light lime	"	590	"
Light slate	"	600	"
Dark slate	"	690	"
Gray sand	"	696	"
Dark slate	"	715	"
Gray lime	"	721	"
Dark slate	"	725	"
Gray lime	"	735	"
Dark slate	"	770	"
Gray sand	"	780	"
Dark slate	"	795	"
Gray sand	"	800	"
Dark slate	"	820	"
Gray lime	"	827	"
Dark slate	"	833	"
Gray sand	"	835	"
Dark slate	"	845	"
Gray sand	"	860	"

Dark slate	to	907	feet
Gray lime	"	910	"
Dark slate	"	933	"
Gray sand	"	947	"
Dark slate	"	955	"
Light sand	"	963	"
Dark slate	"	1010	"
Coal	"	1014	"
Light sand	"	1027	"
Dark slate	"	1040	"
Gray sand	"	1050	"
Dark slate	"	1060	"
Brown sand, oil	"	1062	"
Light sand	"	1066	"

Well No. 1 on the Phoebe Hayden farm, 200 feet to North line, 200 feet to East line. Section 7, Washington Township, Gibson County.

Casing Record

Thirteen feet wood conductor; 1,270 feet 8¼ inch casing; 142 feet 7 inch casing (liner).

Shot Record

One hundred forty quarts, 1,375 feet to 1,398 feet.

Formation Record

Formation		Depth		
Soil	to	1	foot.	
Yellow clay	"	20	feet.	
Quick sand	"	28	"	
Yellow clay	"	43	"	
Dark lime	"	53	"	
Dark slate	"	73	"	
Light slate	"	77	"	
Dark lime	"	79	"	
Light slate	"	98	"	
Dark lime	"	104	"	
Dark slate	"	155	"	
Light slate	"	160	"	
Gray lime	"	220	"	
Dark slate	"	232	"	
Gray lime	"	243	"	
Dark slate	"	248	"	
Gray lime	"	250	"	
Dark slate	"	255	"	
Gray lime	"	295	"	12½" set at 256'
Dark slate	"	325	"	
Light slate	"	335	"	
White lime	"	340	"	
Dark slate	"	380	"	
Sand and lime	"	400	"	
Gray lime	"	409	"	

Formation		Depth		
Dark slate	to	419	feet	
Gray lime	"	423	"	
Dark slate	"	428	"	
Light sand	"	435	"	
Gray lime	"	455	"	
White lime	"	465	"	
White slate	"	470	"	
Light sand	"	474	"	
Light slate	"	475	"	
Gray lime	"	479	"	
Light slate	"	481	"	
Dark slate	"	550	"	
Coal	"	554	"	
White slate	"	565	"	
White lime	"	573	"	
Brown slate	"	580	"	
Dark slate	"	600	"	
Gray lime	"	609	"	
Dark slate	"	621	"	
Gray lime	"	626	"	
Dark slate	"	629	"	
Gray lime	"	641	"	
Light slate	"	648	"	
Dark slate	"	650	"	
White slate	"	676	"	
Dark slate	"	705	"	
Gray lime	"	710	"	
Dark slate	"	715	"	
White slate	"	722	"	
Dark slate	"	770	"	
Gray lime	"	774	"	
Dark slate	"	824	"	
Dark slate	"	830	"	10" set at 829'
Gray lime	"	834	"	
Dark slate	"	840	"	
Dark sand	"	845	"	
Dark slate	"	849	"	
Dark sand	"	860	"	
Dark slate	"	865	"	
White lime	"	869	"	
Brown sand	"	874	"	
Brown slate	"	880	"	
Gray lime	"	884	"	
Dark slate	"	885	"	
Gray lime	"	889	"	
Dark slate	"	900	"	
Gray sand	"	950	"	
White slate	"	951	"	

Formation		Depth
Gray sand	to	990 feet
Dark slate	"	1012 "
Gray lime	"	1020 "
Light sand	"	1030 "
Dark slate	"	1128 "
Gray sand	"	1137 "
Dark slate	"	1170 "
Gray sand	"	1180 "
Dark slate	"	1190 "
Gray lime	"	1195 "
Gray sand	"	1218 "
Dark slate	"	1240 "
Gray sand	"	1245 "
Brown lime	"	1252 "
Dark slate	"	1260 "
Gray sand	"	1269 "
Dark slate	"	1270 "
Brown lime	"	1272 " 8¼" set at 1270'
Dark slate	"	1286 "
Dark lime	"	1289 "
Dark slate	"	1345 "
Light sand	"	1347 "
Dark slate	"	1353 "
Gray lime	"	1360 "
Dark slate	"	1374 "
Gray sand	"	1398 "
Dark slate	"	1402 "

First shows oil at 1375 feet.

Well No. 2 on farm of Phoebe Hayden, 200 feet to North line, 200 feet to West line. Washington Township, Section 7, Gibson County,

Shot Record

One hundred quarts, 1,358 feet to 1,381 feet.

Formation Record

Formation		Total Depth
Soil	to	1 foot.
Yellow clay	"	23 feet.
Dark slate	"	37 "
Light slate	"	42 "
Gray lime	"	66 "
Light slate	"	73 "
Coal	"	75 "
Dark slate	"	91 "
Gray sand	"	94 "
Light slate	"	112 "
Dark slate	"	122 "
Gray sand	"	140 "
Light sand	"	175 "

Formation		Depth		
Light slate	to	195	feet	
Coal	"	201	"	
Light slate	"	222	"	
Gray lime	"	230	"	
Light slate	"	240	"	
White sand	"	261	"	
Dark slate	"	295	"	
Gray lime	"	298	"	12½" set at 295'
Dark slate	"	325	"	
Light slate	"	360	"	
Dark sand	"	373	"	
Dark slate	"	400	"	
Light sand	"	408	"	
Dark slate	"	423	"	
Gray sand	"	445	"	
Dark slate	"	460	"	
Light slate	"	483	"	
Dark slate	"	535	"	
Black slate	"	550	"	
Dark slate	"	567	"	
Coal	"	572	"	
Gray lime	"	576	"	
Dark slate	"	594	"	
Gray lime	"	603	"	
Light slate	"	617	"	
Dark slate	"	624	"	
Gray lime	"	630	"	
Light slate	"	658	"	
Coal	"	663	"	
Light slate	"	675	"	
Dark slate	"	677	"	
Gray lime	"	680	"	
Dark slate	"	766	"	
Light sand	"	770	"	
Dark slate	"	775	"	
Gray sand	"	785	"	
Dark slate	"	821	"	
Gray sand	"	825	"	
Dark slate	"	835	"	
Gray sand	"	840	"	
Dark slate	"	885	"	
Dark sand	"	915	"	
Dark slate	"	963	"	
Coal	"	965	"	
Light sand	"	985	"	
Dark slate	"	1027	"	
Gray lime	"	1033	"	10" set at 1029'
Dark slate	"	1048	"	
Black slate	"	1052	"	

Formation	Depth		
Dark slate	to 1067	feet	
Light sand	" 1100	"	
Dark slate	" 1120	"	
Light sand	" 1200	"	
Dark slate	" 1206	"	
Gray sand	" 1223	"	
Dark slate	" 1225	"	
Dark lime	" 1229	"	
Dark slate	" 1243	"	
Light sand	" 1272	"	
Light slate	" 1286	"	
Gray lime	" 1289	"	8¼" set at 1286'
Dark slate	" 1295	"	
Dark sand	" 1297	"	
Dark slate	" 1303	"	
Dark sand	" 1309	"	
Light sand	" 1324	"	gas 1313-1322
Dark slate	" 1339	"	
Gray lime	" 1342	"	6⅝" set at 1340'
Gray slate	" 1360	"	
Gray sand	" 1362	"	
Dark sand	" 1366	"	
Light sand	" 1372	"	
Brown sand	" 1381	"	

Top of sand 1360 feet.
First show of oil 1361 feet.

Well No. 3 on the farm of Phoebe Hayden, 200 feet to North line, 660 feet to West line. Washington Township, Section 7, Gibson County.

Casing Record

Fourteen feet wood conductor, 1,298 feet 8¼ inch casing, 134 feet 6⅝ inch casing (liner).

Shot Record

One hundred twenty quarts, 1,398 feet to 1,416 feet.

Formation Record

Formation	Depth	
Soil	to 1	foot.
Yellow clay	" 11	feet.
Yellow sand	" 60	"
Dark slate	" 65	"
Coal	" 67	"
Dark slate	" 71	"
Light lime	" 73	"
Light slate	" 110	"
Dark slate	" 127	"
Gray sand	" 130	"
Dark slate	" 150	"
Gray lime	" 205	"

Formation		Depth		
White sand	to	225	feet	
Blue slate	"	250	"	
Gray lime	"	253	"	12½" set at 250'
Dark slate	"	262	"	
Light lime	"	300	"	
Dark slate	"	320	"	
Coal	"	323	"	
Dark slate	"	330	"	
Light slate	"	400	"	
Gray lime	"	410	"	
Light slate	"	420	"	
Gray sand	"	440	"	
Dark slate	"	449	"	
Light sand	"	455	"	
Dark lime	"	463	"	
Light sand	"	480	"	
Light slate	"	525	"	
Dark slate	"	560	"	
Black slate	"	567	"	
Dark slate	"	577	"	
Light slate	"	590	"	
Dark slate	"	597	"	
Gray sand	"	599	"	
Dark slate	"	603	"	
Dark lime	"	607	"	
Coal	"	612	"	
Light sand	"	625	"	
Dark slate	"	635	"	
Dark lime	"	650	"	
Light slate	"	665	"	
Brown lime	"	672	"	
Light slate	"	685	"	
Dark lime	"	700	"	
Dark slate	"	720	"	
Dark lime	"	725	"	
Dark slate	"	775	"	
Gray sand	"	788	"	
Dark slate	"	839	"	
Brown lime	"	845	"	10" set at 839'
Light slate	"	855	"	
Gray lime	"	860	"	
Gray sand	"	872	"	
Dark sand	"	888	"	
Dark sand	"	925	"	
Dark slate	"	930	"	
Dark sand	"	945	"	
Dark slate	"	965	"	
Dark sand	"	984	"	

Formation		Depth		
Dark slate	to	1012	feet	
White sand	"	1040	"	
Dark slate	"	1088	"	
Coal	"	1090	"	
Dark slate	"	1114	"	
Light slate	"	1119	"	
Light sand	"	1135	"	
Dark slate	"	1175	"	
Light sand	"	1185	"	
Dark slate	"	1190	"	
Dark lime	"	1193	"	
Dark slate	"	1197	"	
Dark sand	"	1270	"	
Dark slate	"	1272	"	
Brown lime	"	1274	"	
Light sand	"	1298	"	water
Brown lime	"	1302	"	8¼" set at 1298'
Light sand	"	1308	"	
Dark slate	"	1317	"	
Gray lime	"	1319	"	
Dark slate	"	1340	"	
Light sand	"	1359	"	Gas at 1357'
Dark slate	"	1369	"	
Gray lime	"	1383	"	
Dark slate	"	1398	"	
Dark sand	"	1403	"	first oil 1400'
Light sand	"	1408	"	
Gray sand	"	1415	"	
Dark slate	"	1425	"	

McRoberts well No. 2. Section 6, Washington Township, Gibson County.

Yellow clay	to	25	feet.
Shelly slate	"	38	"
Light slate	"	116	"
Dark slate	"	218	"
Light lime	"	296	"
Light sand	"	327	"
Light slate	"	340	"
Light sand	"	354	"
Broken lime	"	385	"
Light slate	"	407	"
White lime	"	449	"
Light slate	"	502	"
Dark slate	"	536	"
Light slate	"	551	"
Dark slate	"	560	"
Light lime	"	568	"
Light slate	"	621	"

Dark slate	to	662	feet
Light slate	"	748	"
Dark slate	"	763	"
Sandy slate	"	783	"
Dark slate	"	814	"
Light slate	"	833	"
Gray lime	"	842	"
Dark slate	"	851	"
Light slate	"	859	"
Light slate	"	909	"
Water sand	"	953	"
Dark slate	"	984	"
Brown lime	"	989	"
Dark slate	"	998	"
Sandy lime	"	1003	"
Dark slate, show of oil	"	1042	"
Gray sand	"	1057	"
Dark slate	"	1088	"
White sand	"	1129	"
Gray lime	"	1138	"
White slate	"	1152	"
Light water sand	"	1207	"
Dark slate	"	1240	"
Gray lime	"	1255	"
Brown slate	"	1286	"
Brown lime	"	1291	"
Brown slate	"	1315	"
Light sand	"	1318	"
Light slate	"	1326	"
Light lime	"	1331	"
Light slate	"	1337	"
Light sand	"	1342	"
Light lime	"	1347	"
Dark slate	"	1358	"
Light lime	"	1363	"
Light sand, water	"	1368	"
Light sand	"	1382	"
Dark slate	"	1448	"
Gray lime	"	1453	"
Dark sand	"	1484	"
Dark slate	"	1494	"
Brown lime	"	1501	"
Dark slate	"	1516	"
White sand	"	1522	"
Brown sand	"	1531	"

Total depth of the well 1,532 feet. Heavy showing of gas. Well completed on September 25, 1919. Gas well.

Log of L. W. McDonald well No. 6 located in S. W. corner of the N. E. ¼ of the N. W. ¼ of Section 7, Washington Township, Gibson County.

Top of sand		1323	feet.
Oil pay	1324 to	1341	"
Shelly gray sand	1341 "	1349	"
Bottom of well		1349	"

Finished December 4th, 1919.

Well No. 1, Ellis Lucas, Section 33, Montgomery Township, Gibson County.

Dark soil	to	10	feet.
Light sand	"	50	"
White slate	"	75	"
Broken sand, water	"	90	"
White slate	"	135	"
White sand	"	145	"
White slate	"	225	"
Broken sand	"	235	"
Gray lime	"	260	"
Dark slate	"	430	"
Lime shell	"	435	"
White sand	"	490	"
White slate	"	555	"
Lime shell	"	575	"
Coal	"	580	"
Black slate	"	610	"
Gray lime	"	615	"
Sand	"	645	"
White slate	"	690	"
White lime	"	695	"
Dark slate	"	790	"
Sand	"	800	"
Coal	"	806	"
Lime	"	811	"
White slate	"	850	"
Broken lime	"	865	"
White slate	"	890	"
White lime	"	910	"
White slate	"	920	"
White lime	"	950	"
Brown slate	"	990	"
Brown lime	"	1005	"
Dark slate	"	1007	"
White sand	"	1095	"
White slate	"	1100	"
Gray lime	"	1110	"
Brown slate	"	1120	"
Brown lime	"	1130	"

Light slate	to 1140	feet
Light sand	" 1215	"
Dark slate	" 1235	"
Dark lime	" 1245	"
Dark sand	" 1255	"
Dark slate	" 1310	"
Broken sand	" 1330	"
Dark slate	" 1360	"
Brown sand	" 1390	"
Black slate	" 1425	"
Lime shell	" 1430	"
Light slate	" 1440	"
Light lime	" 1450	"
Light slate	" 1490	"
Dark slate	" 1500	"
Light slate	" 1510	"
Dark slate	" 1520	"
Light slate	" 1540	"
Light lime	" 1565	"
Light slate	" 1575	"
Dark lime	" 1585	"
Light slate	" 1600	"
Light lime	" 1605	"
Light slate	" 1610	"
Dark lime	" 1615	"
Light slate	" 1625	"
Sharp sand	" 1640	"
Black slate	" 1660	"
Light lime	" 1670	"
Light slate	" 1690	"
Sand	" 1710	"
Black slate	" 1718	"
Black lime	" 1721	"
Black slate	" 1735	"
Gray lime	" 1745	"
Slate and lime	" 1780	"
Blue slate	" 1805	"
Light limestone	" 1815	"
Blue slate	" 1875	"
Lime shell	" 1880	"
Dark slate	" 1920	"
Gray lime	" 1925	"
Dark slate	" 1940	"
Gray sand	" 1945	"
Dark sand	" 1995	"
Dark lime	" 2000	"
Dark lime	" 2010	"
Dark slate	" 2040	"

Light sand	to 2070 feet
Dark lime	" 2075 "
Dark sand	" 2080 "

Well completed Dec. 15, 1919. Dry hole, abandoned.

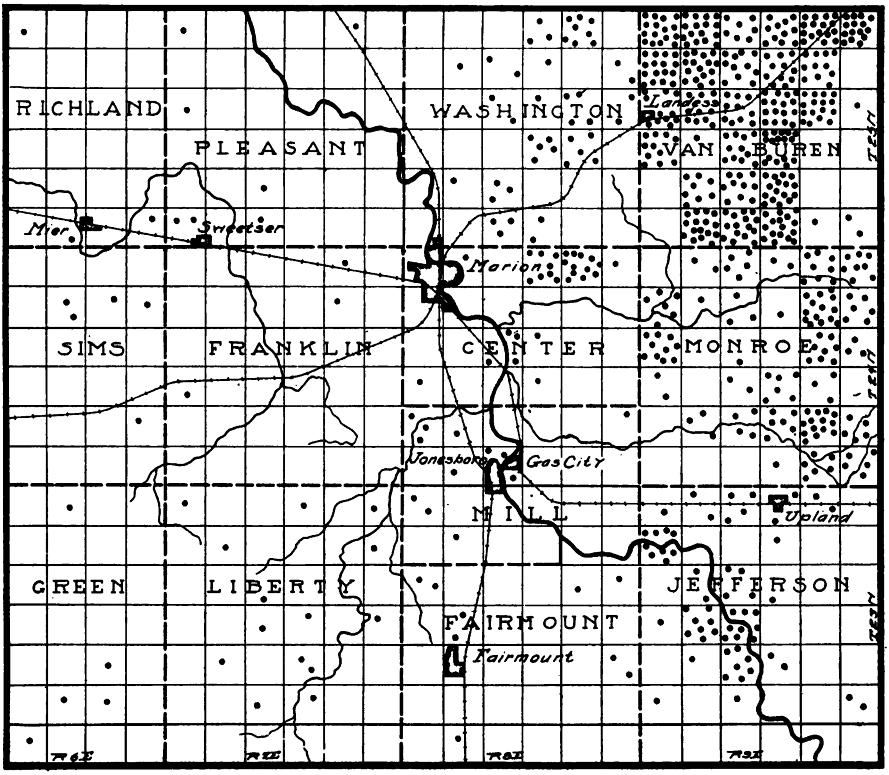

Fig. 35. Map of Grant County showing location of recorded abandoned wells. The northeastern part of this county is oil territory and the southeastern part is gas territory.

GRANT COUNTY

Grant County is covered with glacial drift which varies in thickness from 100 to 425 feet. Except for exposures along the Mississinewa River and Pike Creek the bed rock is completely concealed. The drift rests on the Silurian surface which has been greatly eroded.

Centre Township. The city of Marion in this Township was one of the first to prospect for oil and gas. The first well reached the Trenton at a depth of 865 feet, or 60 feet below sea level and produced 350,000 cubic

feet of gas daily, but after being deepened produced two million cubic feet daily. The second well reached the Trenton at 880 feet or 83 feet below sea level. At the top of the sand it produced 350,000 cubic feet, 35 feet deeper it produced five million cubic feet daily.

The following table gives the records of some of the wells drilled at Marion:

Record of Marion Wells

No. of Well.	Altitude.	Depth of Trenton.	Relation to Sea Level.	Thickness of Drift.	Production in Cu. Ft.
1	840	900	60 feet below	......	2,000,000
2	797	880	83 " "	......	5,000,000
3	820	878	58 " "	......	3,500,000
4	802	880	78 " "	......	2,500,000
5	830	1000	70 " "	......	4,000,000
6	......	908	....	32	350,000
7	701	904	....	......	3,000,000
8	......	......	....	......	3,000,000
9	......	......	....	......	1,500,000
10	......	......	....	......	oil and gas
11	......	......	....	......	7,425,000
12	......	......	....	......	Oil and 350,000
13	......	......	....	......	5,642,000
Soldiers' Home					
2	......	......	....	20	Salt water

Record of Well No. 6

Drift	32	feet.
Limestone	250	"
Niagara shale	40	"
Hudson River	336	"
Utica shale	250	"
Total depth	908	feet.

Wells abandoned in 1911 are located as follows: Section 1, 1 well; Section 2, 12 wells; Section 3, 8 wells; Section 5, 1 well; Section 15, 1 well; Section 16, 4 wells; Section 19, 1 well; Section 22, 1 well.

Mill Township. A well drilled at Jonesboro produced 5,567,000 cubic feet of gas. It was called the "Cyclone" on account of its pressure. A record of the well is given by Phinney as follows:

Drift	162	feet.
Limestone	148	"
Bluish green shale	225	"
Gray shale	180	"
Brown shale	197	"
Trenton	23	"
Total	935	"
Altitude at well about	834	"

The following wells have been abandoned: Section 6, 2 wells, 1911; Section 8, 1 well, 1911; Section 29, 1 well in 1912; Section 30, 3 wells, 1912; Section 32, 1 well, 1912; Section 33, 2 wells, 1912.

Oil has been obtained from nearly all of the section in this Township and gas from many.

Fairmount Township. The first well drilled at Fairmount produced 11,500,000 cubic feet of gas per day. A second well produced 5,000,000 cubic feet per day.

Record of Fairmount Well No. 1 (Phinney)

Drift	35	feet.
Limestone	290	"
Shale	609	"
Trenton limestone	31	"
Total depth	965	"
Altitude of well	893	"

A well drilled in Section 25, has a record as follows: (Blatchley)

Drive pipe	190	feet.
Casing	370	"
Trenton limestone	950	"
Oil sand	975	"
2nd oil sand	1030	"
Total depth	1050	"
Initial production	50	barrels.

Well in Section 2

Drive pipe	170	feet.
Casing	380	"
Top of Trenton	960	"
Oil sand	990	"
Second oil sand	1025	"
Total depth	1040	"

Wells have been abandoned in this Township as follows: Section 5, 1 well in 1912; Section 13, 1 well, 1912; Section 14, 1 well, 1912; Section 18, 1 well, 1911; Section 20, 1 well, 1911; Section 25, 1 well, 1911.

Jefferson Township. The first well drilled at Upland reached the Trenton at 1,010 feet. The oil sand was 10 feet thick and the total depth of the well 1,040 feet. The drift was 185 feet thick. Sixteen wells were drilled in this township in 1906, 13 were light producers. Forty wells were abandoned the same year. Below is a record of four wells in this Township, all of which produce gas, and the first one oil.

	S. E. ¼ of N. W. ¼ of Sec. 28.	Sec. 19.	Sec. 19.	Sec. 17.
Drive pipe	100	187	162	100
Casing	420	375	375	365
Top of Trenton	920	933	925	886
Total depth	1020	1035	953	911

Well No. 2. Davis Farm, Jefferson Township, Grant County, Indiana.

Clay, gravel and quicksand	107	feet.
Limestone	247	"
Slate	577	"
Trenton rock at	931	"
In Trenton	102	"
Total depth	1033	"

Well No. 14. Mary Anderson Farm. Jefferson Township, Grant County, Indiana.

Clay, gravel and quicksand	112	feet.
Limestone	268	"
Slate	563	"
Trenton rock at	943	"
In Trenton	107	"
Total depth	1050	"

Well No 1. Highline Farm. Jefferson Township, Grant County, Indiana.

Clay, gravel and quicksand	129	feet.
Limestone	227	"
Slate	580	"
Trenton rock at	938	" 6"
In Trenton	102	"
Total depth	1041	"

Well No. 2. A. D. Mittank Farm. Jefferson Township, Grant County.

Clay, gravel and quicksand	116	feet.
Limestone	249	"
Slate	549	"
Trenton rock at	916	"
In Trenton	100	"
Total depth	1016	"

Well No. 3. A. D. Mittank Farm.

Clay, gravel and quicksand	102	feet.
Limestone	256	"
Slate	558	"
Trenton rock at	916	"
In Trenton	107	"
Total depth	1023	"

Every section in this Township has produced either oil or gas or both. The following wells have been abandoned: Section 2, 2 wells; Section 3, 2 wells; Section 4, 4 wells; Section 5, 2 wells; Section 6, 1 well; Section 7, 9 wells; Section 10, 1 well; Section 15, 1 well; Section 16, 4 wells; Section 17, 2 wells; Section 19, 1 well; Section 20, 8 wells; Section 21, 9 wells; Section 27, 2 wells; Section 28, 7 wells; Section 29, 1 well; Section 31, 1 well; Section 33, 1 well; Section 36, 2 wells.

Monroe Township. The records of two wells are given below:

	Sec. 12	Sec. 36
Drive pipe	425 feet	227 feet.
Casing	430 "	403 "
Top of Trenton	990 "	995 "
Gas sand	...... "	1030 "
Water	...... "	1049 "
Total depth	1050 "	1077 "

More than one-half of the sections in this Township have produced oil or gas or both.

Abandoned wells: Section 1, 8 wells; Section 2, 8 wells; Section 3, 2 wells; Section 4, 5 wells; Section 5, 2 wells; Section 7, 6 wells; Section 8, 1 well; Section 9, 3 wells; Section 10, 1 well; Section 11, 14 wells; Section 12, 6 wells; Section 13, 2 wells; Section 14, 8 wells; Section 15, 1 well; Section 16, 1 well; Section 17, 1 well; Section 18, 10 wells; Section 19, 2 wells; Section 21, 2 wells; Section 22, 6 wells; Section 23, 3 wells; Section 25, 5 wells; Section 26, 14 wells; Section 27, 6 wells; Section 28, 4 wells; Section 29, 2 wells; Section 34, 1 well; Section 35, 6 wells; Section 36, 6 wells.

Pleasant Township. Light producing wells have been found in this township. Two wells were drilled near Jalapa in 1901 and 1903, both light producers. Wells abandoned are located as follows: Section 2, 1 well; Section 6, 1 well; Section 18, 1 well; Section 28, 1 well; Section 31, 2 wells; Section 33, 1 well.

Richland Township. Salt water was obtained in a well drilled about two miles from the north boundary. Wells were abandoned in Section 4, 1 well; Section 34, 1 well; Section 36, 1 well.

Sims Township. A strong gas supply was obtained at Swayzee. Two wells were put down in Section 12, both produced a small supply of oil. Wells abandoned are as follows: Section 2, 1 well, 1913; Section 9, 1 well, 1913; Section 10, 2 wells, 1911; Section 25, 1 well, 1912.

Van Buren Township. The first well drilled contained both oil and gas. A record of the well drilled at Van Buren is given below.

Log of Van Buren Well No. 1

Drift	91 feet.
Limestone	300 "
Shale	559 "
Trenton limestone	23 "
Total depth	973 "
Altitude of well	843 "

The following are records of other wells drilled in this township:

	Sec. 2	Sec. 7	Sec. 17
Drive pipe	174	156	412
Casing	460	439	441
Top of Trenton	992	1003	972
Gas	1007	1012	987
Oil (first)	1020	1018	1005
Oil (best)	......	1038	......
Total depth	1046	1085	1032
Initial production	20 bbl.	65 bbl.	30 bbl.

Every quarter section of land in this Township has been a producer of oil or gas or both. The following wells have been plugged: Section 1, 15 wells; Section 2, 23 wells; Section 3, 11 wells; Section 4, 7 wells; Section 5, 19 wells; Section 6, 33 wells; Section 7, 22 wells; Section 8, 21 wells; Section 9, 11 wells; Section 10, 11 wells; Section 11, 11 wells; Section 13, 1 well; Section 14, 19 wells; Section 15, 56 wells; Section 16, 6 wells; Section 17, 10 wells; Section 18, 11 wells; Section 19, 11 wells; Section 20, 1 well; Section 21, 12 wells; Section 22, 19 wells; Section 27, 16 wells; Section 28, 10 wells; Section 29, 8 wells; Section 32, 20 wells; Section 33, 29 wells; Section 34, 38 wells; Section 35, 1 well; Section 36, 2 wells.

Washington Township. A few sections in the northwest corner of the Township are the only ones that have not been productive. Wells No. 1 on the N. M. Bradford, and No. 1 on the Ira Bradford farm, in the north half of the southeast ¼ of 16, and No. 11 on the J. T. Bradford in the S. W. ¼ of 16, had the following records:

	No. 1 N. M. B. feet.	No. 2 I. B. feet.	No. 11 J. T. B. feet.
Drive pipe	285	256	341
Casing	509	409	442
Top of Trenton	995	996	994
Gas	1020	1020	1020
Best oil	1040	1030	1055
Total depth	1071	1071	1094
Initial production, bbls.	25	60	15

Section 2, E. J. Hunt farm, S. W. ¼. An average well on the lease shows the following record:

Drive pipe	300	feet.
Casing	500	"
Top of Trenton	980	"
Total depth	1055	"

On Section 3, one mile west of the above farm, a record of bore No. 1 was as follows (the well was a fair producer):

Drive pipe	199	feet.
Casing	504	"
Top of Trenton	1004	"
Gas struck at	1014	"

First oil pay	1019–1040 feet
Salt water	1040–1045 "
Second oil pay	1055–1070 "
Total depth	1070 "

A well in the N. E. ¼ of Section 11 had the following record:

Drive pipe	250 feet.
Casing	455 "
Top of Trenton	1014 "
First pay	1026 "
Salt water	1073 "
Total depth	1077 "

The above well started at 60 barrels.

An average record of ten wells drilled on the Cory lease, west half of the northwest ¼, up to October 1, 1903, is as follows:

Drive pipe	104 feet.
Casing	460 "
Top of Trenton	1001 "
Total depth	1079 "

Most of the wells came in with an initial production of 35 to 50 barrels.

A well on the L. W. Smith farm, Section 16, south half of the N. W. ¼ has the following record:

Drive pipe	220 feet.
Casing	470 "
Top of Trenton	930 "
Total depth	1000 "

Section 28, N. E. ¼.

Drive pipe	286 feet.
Casing	420 "
Top of Trenton	987 "
Struck gas at	1000 "
Total depth	1074 "

The well yielded 2,000,000 feet of gas a day for twenty days, with no showing of oil. At the end of that time it was shot with 160 quarts, when a pocket of oil near the bottom of the bore was evidently broken into, as the fluid rose 20 feet above the derrick. The well made 24 barrels the first day and settled down into a fair producer.

The Hawkins lease, on the N. W. ¼ of Section 34 has 7 or 8 fair producers. The record of No. 7 being as follows:

Drive pipe	173 feet.
Casing	440 "
Top of Trenton	997 "
First oil pay	1027 "
Second oil pay	1054 "
Total depth	1070 "

Abandoned wells are located as follows: Section 2, 8 wells, 1913; Section 3, 3 wells, 1913; Section 9, 2 wells, 1912; Section 10, 1 well, 1916; Section 12, 2 wells, 1912; Section 13, 3 wells, 1912; Section 14, 4 wells,

1912; Section 15, 1 well, 1913; Section 16, 2 wells, 1912; Section 22, 5 wells, 1913; Section 23, 5 wells, 1913; Section 28, 3 wells, 1913; Section 33, 3 wells, 1912; Section 34, 2 wells, 1912.

Green Township. Abandoned wells are located as follows:

Owner.	Date.	Section.	Range.	Wells.
E. Pennington	1912	3	6E	1
Joe Hoe	1913	4	6E	1
J. J. Johnson	....	16	6E	1
G. M. Kilgore	1912	26	6E	1
N. J. Lacure	1912	34	6E	1
Chas. Lear	1913	35	6E	1

Liberty Township. A list of the abandoned wells is given below:

Owner.	Date.	Section.	Range.	Wells.
A. W. Jay	1912	1	7E	1
Henry Daugherty	1913	3	7E	1
A. Gimmell	1912	6	7E	1
P. & N. Muchmore	1912	8	7E	1
Thos. Shady	1912	12	7E	1
F. A. Stewart	1912	16	7E	1
W. W. Elliott	1912	21	7E	1
John Harold	1912	22	7E	1
Jessie Haisley	1912	24	7E	1
Frank Mason & Webb Winslow	1912	27	7E	2
Woodie Clark	....	29	7E	1
Thos. Shady	....	33	7E	1
Wm. Harvey	....	34	7E	1

Franklin Township. Wells were drilled and abandoned as follows:

Owner.	Date.	Section.	Range.	Wells.
H. J. Paulus	1912	2	7E	1
B. D. Tharp	1911	11	7E	1
Mat Sheffield	1911	19	7E	1

GREENE COUNTY

The mantle of glacial drift covering this County is light, varying from five to fifty feet in thickness except in the White River valley where it may exceed one hundred feet. The rock strata underlying the drift belongs to the Mississippian and the Pennsylvanian periods. In the eastern part of the county the structure may be determined by locating elevations on the surface of some of the Chester limestones which may be used as datum planes for drawing structural contours. In the western part of the County where the coal measures outcrop the coal beds may be used, with proper methods of discrimination, for a like purpose. The surface of the Trenton limestone probably lies from 2,000 to 2,500 feet below the surface in this County. The Devonian, which may be oil bearing where the structure is favorable, may be reached at depths ranging from 1,500 to 1,800 feet.

Jefferson Township. A well drilled at Worthington reached water in the Niagara limestone at 1,430 feet. The well was completed at 1,445 feet.

Taylor Township. A well drilled in Taylor Township has the following record:

Well No. 1 on Section 31

Surface to 15 feet—Soil, drift and mud.

15	to	20	feet.	—Quick sand	5 feet.
20	"	40	"	—Soft mud	20 "
40	"	45	"	—Limeshell	5 "
45	"	72	"	—Shale and water	27 "
72	"	80	"	—Limeshell	8 "
80	"	100	"	—Shale and water	20 "
100	"	120	"	—Lime	20 "
120	"	125	"	—Broken shale	5 "
125	"	250	"	—Limestone full of water.	
250	"	300	"	—Soft black mud.	
300	"	310	"	—Limeshell	10 "
310	"	610	"	—Hard limestone	300 "
610	"	615	"	—Soft lime	5 "

At 610 feet lime got soft and brown, with a smell of gas and you could just notice a rainbow of a color of oil.

615	to	710	feet.	—Brown limestone.
710	"	800	"	—Brown lime full of water.
800	"	1250	"	—Black shale.
1250	"	1285	"	—Lime shell.
1285	"	1290	"	—Very hard lime.
1290	"	1400	"	—Dark shale.
1400	"	1487	"	—Brown shale.
1487	"	1642	"	—Niagara rock.

Total depth of well........1642 feet.

Washington Township. A small gas and oil field was located at Lyons. The production was never very large. Wells were abandoned in Section 4, Section 6, Section 9, Section 11, Section 15, and Section 16. The following is a record of the Kaufman well:

Drift	26	feet.
Sandy lime	60	"
Coal	4	"
Sand and water	86	"
Slate	20	"
White lime	30	"
Red rock	35	"
Sandy slate	10	"
Dark slate	55	"
Bedford lime	8	"
Dark shaley lime	342	"
Shell and lime	100	"

Brown slate and water	10	feet
Black lime	40	"
Hard white lime	50	"
Slate and shale	60	"
White lime	40	"
Black slate	250	"
Brown sand	50	"
White slate	238	"
Trenton rock	221	"

Still in Trenton when finished at 1,959. Big water at 1,950. Filled up to 1900. This well probably finished in the Niagara rather than the Trenton. Casing record, 10 inch, 209 feet; 8 inch, 620 feet; 6⅝ inch, 1,188 feet.

Stafford Township. Two wells were drilled in this Township, one on the property of J. L. Morgan and in Glenns Valley.

HAMILTON COUNTY

The bed rock formations of this County belong to the Silurian and Devonian periods of geologic time. These formations are largely concealed by glacial drift varying in thickness from 50 to 300 feet. The surface of the Trenton lies from 800 to 1,200 feet below the surface and for the greater part of the County is above sea level. The dip of the strata is southwest.

Noblesville Township. A well drilled at Noblesville gave the following log:

Drift	140	feet.
Limestone	286	"
Shale	410	"
Trenton limestone	7	"
Total	843	feet.
Altitude of well	750	"

Many gas wells are located in this Township. Abandoned wells are located in Section 11, 1 well; Section 17, 1 well; Section 18, 2 wells.

Delaware Township. Gas wells were located at New Britton and Fishers.

Fall Creek Township. Oil wells were located in Sections 1, 2, 36 and others.

Logs of Wells in Section 2[3]

	No. 1.	No. 2.	No. 3.
Drive pipe	56	54	54
Casing	380	384	381
Top of Trenton	886	889	885
Best oil at	914	918	914
Total depth	926	955	935
Initial output, barrels	65	2	50

Jackson Township. Oil wells were located in Sections 5, 6, 31, 33, 36 and others. Three abandoned wells are located in 28 and 1 in 23. Logs of some of the wells are as follows:

	Sec. 6.	Sec. 5.	Sec. 36.
Drive pipe	203	240	70
Casing	525	545	......
Top of Trenton	1003	1010	916
Total depth	1063	1064	927

The record of a well drilled at Cicero is given below:

Drift	161	feet.
Niagara limestone and shale	300	"
Hudson River and Utica	490	"
Trenton limestone	32	"

Phinney gives the following record of a well drilled at Arcadia:

Drift	130	feet.
Limestone	120	"
Blue limestone	130	"
Shale	581	"
Trenton limestone	13	"
Total depth	974	"
Altitude of well	868	"

Adams Township. At Sheridan gas was obtained at 1,076 feet and the top of the Trenton at 1,069 feet.

Washington Township. At Westfield the top of the Trenton was reached at 1,040 feet and salt water at 1,080 feet. Blatchley gives the records of five wells in this Township, the first three are in the S. W. ¼ of Section 13, and the last two in the east half of Section 20.

	No. 1	No. 2	No. 3	No. 4	No. 5
Drive pipe	305	231	234	160	161
Casing	560	500	500	515	515
Top of Trenton	1024	1020	1022	1005	1000
Total depth	1042	1037	1050	1032	1019

An abandoned well is located in Section 26, on the Allan Stalker property.

Clay Township. At Carmel gas was obtained.

Wayne Township. Abandoned wells are located in this territory as follows: One well each in Sections 3, 5, 9, 10, 17 and 20 and two in Section 9.

White River Township. Abandoned wells are located as follows: One each in Sections 3, 9, 10, 27 and 34.

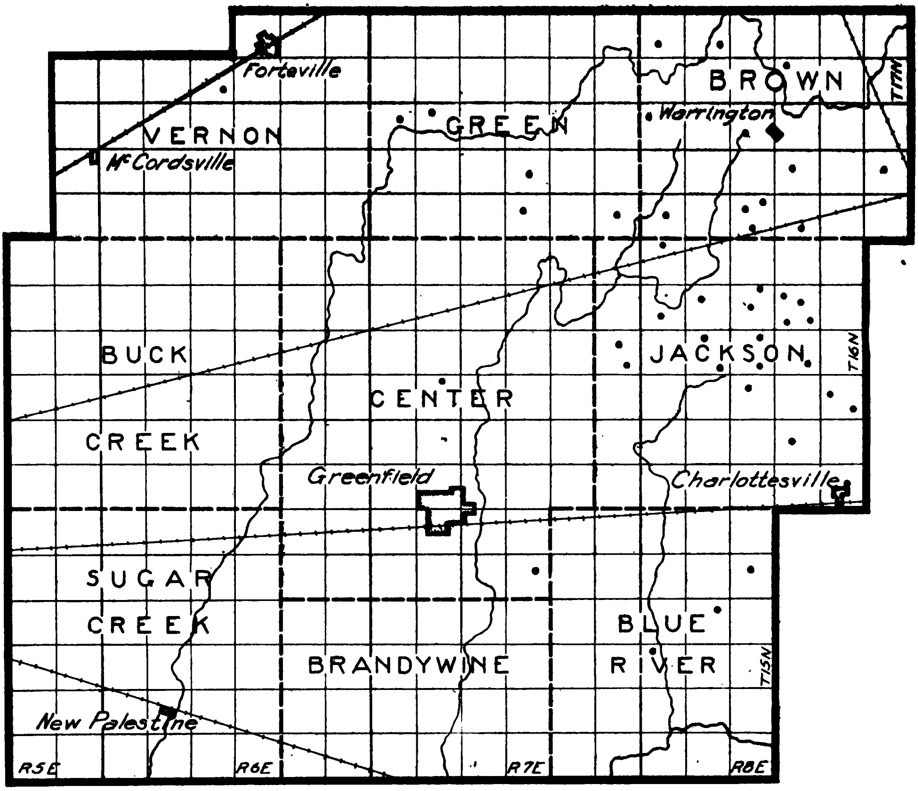

Fig. 36. Map of Hancock county showing abandoned wells. Gas areas occur in the following townships: Vernon, Buck Creek, Brandywine and Blue River.

HANCOCK COUNTY

This county is covered with glacial drift varying in thickness from 50 to 250 feet. The durolith formations belong to the Silurian and the Devonian periods. In the greater part of the county the surface of the Trenton is above sea level in the southwest corner of the County it lies below sea level.

Centre Township. Productive gas wells were drilled at Greenfield. A record of well No. 1 as given by Phinney is below:

Drift	215	feet.
Corniferous limestone	65	"
Shale (upper Niagara)	17	"
Limestone (Niagara)	68	"
Shale	135	"

Black shale	45 feet
Bluish green shale	138 "
Limestone	2 "
Brown shale	300 "
Trenton limestone	14½ "
Total depth	999½ "
Altitude of well	902 "

Wells drilled on the property of Joe Docman and Max Franks were abandoned in 1912 and one on the property of Joe Branny in Section 20 in 1913.

Sugar Creek Township. The record of a well drilled at Palestine is as follows:

Drift	285 feet.
Limestone	122 "
Shale	593 "
Trenton limestone	60 "
Total	1060 "
Altitude of well	839 "
Salt water at	1003 "

Vernon Township. Gas was obtained in wells at Fortville and McCordsville, Vernon Township. The following wells were abandoned, one each on the property of Wm. Fort and J. Lindamood and one on the property of Nelson Fort in Section 16, all in 1913.

Greene Township. Wells abandoned in this township are located:

Owner.	Section.	Date.	Wells.
Sarah Martin	19	1912	1
Mark O'Mailey	20	1913	1
S. E. Stubbs	27	1916	1
David Jones	34	1916	1
Ora Peacock	36	1919	1

Brown Township. Abandoned wells are located as follows:

Owner.	Section.	Date.	Wells.
Harry Davies	7	1916	1
H. Cook	8	1919	1
J. W. Hedrick	14	1911	1
Madison Brooks	19	1913	1
Frank Burgis	21	1912	1
Hayes	25	1913	1
Joe Van Matre	27	1913	1
Carwood	33	1913	1
W. Keck	33	1913	1
Joe Van Matre	33	1913	1

Jackson Township: Gas was obtained at Charlottsville in Section 35 and in many other sections. The following wells have been abandoned: Section 6, 1 well; Section 7, 1 well; Section 8, 1 well; Section 9, 2 wells; Section 10, 4 wells; Section 13, 2 wells; Section 15, 1 well; Section 16, 2 wells; Section 17, 2 wells; Section 21, 1 well; Section 23, 2 wells; Section 27, 1 well; Section 35, 3 wells.

Blue River Township. The following wells have been abandoned in this Township: One each in Sections 9, 10, 17 and 19.

HARRISON COUNTY

Harrison County lies wholly within the unglaciated area of the state. The greater part of its surface is occupied by the Mitchell peneplain through the surface of which the major streams have cut to the underlying formations. The strata represented by outcrops in the County belong to the following divisions:

Quaternary	Recent—Residual clays and alluvium. Pleistocene—Possible residuals.
Mississippian	Chester, sandstones limestone and shale. Mitchell limestone. Salem limestone. Harrodsburg limestone. Knobstone, shales and sandstones.

In that portion of the county occupied by the Mitchell limestone the determination of structural conditions will be difficult because of the absence of definite and persistent horizons in the Mitchell. Where numerous outcrops of the Knobstone-Harrodsburg contact can be found, this may be used as a key horizon. If structural conditions are favorable, oil and gas reservoirs may be found in the Trenton, Silurian and Devonian limestones. Gas has been obtained at Tobacco Landing from the Devonian. A record of one of the wells follows:

Section of Well No. 1

Keokuk limestone	15 feet.
Knobstone	390 "
Depth to Devonian shale	405 "

A good flow of gas was found in the Devonian shale. The gas pressure in 1911 was from 60 to 110 pounds. In 1914 it was only 50 pounds. Gas and oil wells range in depth from sixty to nine hundred feet. Six oil wells range in depth from 135 feet to 700 feet. The initial production was from five to thirty barrels per day.

HENDRICKS COUNTY

The strata underlying the glacial drift in this County belong to the Devonian and Mississippian periods. The New Albany shale occupies the subsurface in the eastern part of the County and the Knobstone in the western portion. The glacial drift conceals the bed rock almost completely and reaches a thickness of two hundred feet.

A well was drilled at Plainfield at an altitude of 742 feet. The total depth was 1,386 feet and a slight flow of gas was obtained at a depth of 350 feet.

The surface of the Trenton in all parts of this County is below sea level, probably 400 to 600 feet. If oil or gas in quantity is obtained in this County it will probably be in terraces or spurs or small domes connected with the Cincinnati geanticline. The position of such structures, if they exist cannot be determined by surficial observations because the outcrop of the strata is concealed largely by the drift. Not enough well records have been secured to enable one to secure sufficient data for subsurface work.

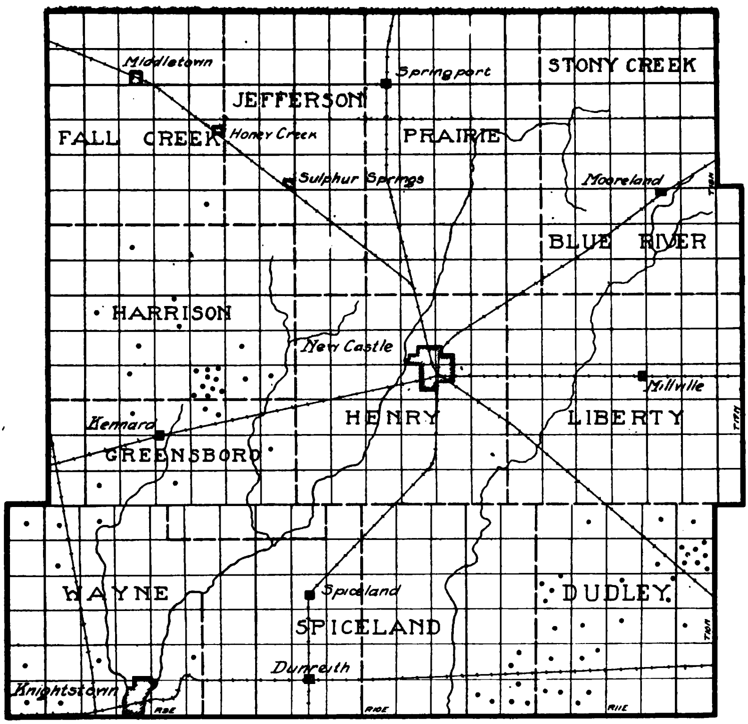

Fig. 37. Map of Henry County showing location of abandoned wells. The northern tier of townships is in gas territory.

HENRY COUNTY

The surface of the durolith of Henry County is formed by Silurian strata (Niagara limestone), which is covered with glacial drift varying in thickness from 25 to 500 feet. The surface of the Trenton lies from 500 to 1,200 feet below the surface of the county and for a large part of the County is above sea level.

Henry Township. Well No. 1 at New Castle has the following log:

Drift	333	feet.
Hudson River Shales	200	"
Utica shales	343	"
Trenton limestone	421	"
Total depth	1297	"
Trenton above sea level	104	"

The surface of the Trenton about New Castle varies in height above sea level from 104 to 137 feet, the average is about 125 feet.

Prairie Township. A well drilled at Mt. Summit gave the following log:

Drift	230	feet.
Limestone	50	"
Shale	736	"
Trenton limestone	66	"
Total depth	1082	"
Altitude of well	1110	"

Two wells were drilled at Springport, the record of the second follows:

Drift	156	feet.
Limestone	90	"
Bluish green shale	600	"
Black shale	111	"
Trenton limestone	63	"
Total depth	1020	"
Altitude of well	1004	"

Spiceland Township. At Spiceland a well was drilled which has the following log:

Drift	151	feet.
Hard cherty limestone	62	"
Limestone	67	"
Shale	10	"
Bluish green and brown shale	710	"
Trenton limestone	62	"
Total depth	1002	"
Altitude of well	1023	"

Wayne Township. A well drilled at Knightstown has the following log:

Drift	64	feet.
Niagara limestone	200	"
Hudson River limestone and shale	360	"
Utica shale	199	"
Trenton limestone	213	"
Total depth	1036	"
Trenton above sea level	113	"

At this point the surface of the Trenton varies from 112 to 121 feet above sea level. Three wells were drilled in Knightstown recently. The

records of these wells are given below. No. 1 was drilled on the lot of Mrs. Walter Garrison; No. 2 on lot of James Oakerson; No. 3 on lot of L. P. Wenly.

	No. 1	No. 2	No. 3	
Drift to lime rock	57	63	60	feet.
Thickness of lime rock	200	200	200	"
Thickness of slate to shale	560	555	560	"
To Trenton	817	818	820	"
Drilled in Trenton	8	10	10	"
Total depth	825	828	830	"

HOWARD COUNTY

A mantle of drift covers the bed rock of this County to a depth of 40 to 100 or more feet. Underlying the drift are the limestones of the Silurian period. This County was among the first to drill for gas and as early as 1886 brought in a well of 2,000,000 cubic feet capacity. The depth to the surface of the Trenton varies from 800 to 1,100 feet and the surface of the Trenton is from 50 to 350 feet below sea level.

Center Township. The Township has produced much gas. The first well was drilled in 1886. The following is a list of 14 wells drilled in or near Kokomo[1]:

No. of well	Depth to Trenton feet	Depth to gas feet	Altitude feet	Trenton below sea level	Thickness of drift	Capacity in cu. ft. per day
1	912	922	825	87	....	2,000,000
2	913	922	....	....	....	1,117,000
3	905	910	830	75	65	810,000
4	936	944	....	....	....	1,500,000
5	895	901	....	....	....	4,462,000
6	889	893	....	....	....	1,555,000
7	908	912	....	....	....	3,015,000
8	904	914	....	....	....	1,072,000
9	900	....	....	....	....	2,500,000
10	902	....	....	....	40	2,800,000
11	932	....	....	....	90	2,600,000
12	....	....	....	....	....	3,650,000
13	903	....	....	....	....	3,727,000
14	905	....	....	....	....	2,330,000

Record of Well No. 4 (Wm. Moore)

Drift	65	feet.
Water lime	10	"
Bluish limestone	80	"
White shaly limestone	15	"
Bluish limestone	65	"
Niagara shale (calcareous)	35	"
Gray limestone	75	"
Hudson River shale	255	"
Utica shale	256	"
Trenton limestone	22	"
Total depth	958	"

At Tarkington the Trenton was reached at 965 feet and the drift has a thickness of 140 feet. In Section 19, 4 wells; Section 20, 8 wells and in Section 24, 1 well, were abandoned from 1911 to 1913.

Jackson Township. Gas wells were produced at Sycamore in this township. Wells abandoned are located as follows: Section 7, 2 wells; Section 12, 3 wells; Section 13, 3 wells; Section 17, 2 wells; Section 18, 1 well; Section 20, 1 well; Section 23, 1 well; Section 24, 5 wells; Section 26, 1 well; Section 31, 1 well; Section 32, 1 well.

Liberty Township. At Greentown a strong flow of gas was obtained. The depth to the Trenton is 936 feet, gas obtained at 965, and the drift was 79 feet. Wells have been abandoned as follows: Section 4, 1 well; Section 6, 1 well; Section 7, 1 well; Section 19, 2 wells; Section 27, 2 wells.

Union Township. The Trenton was reached at 934 feet, gas at 959, and the thickness of the drift was 107 feet. Wells abandoned are located in Section 6, 1 well; Section 7, 1 well; Section 15, 1 well; Section 17, 1 well; Section 20, 2 wells; Section 21, 1 well; Section 23, 1 well; Section 29, 1 well.

Taylor Township. The Fairfield well reached the Trenton at 937, drift 55 feet, McNeal well went through 32 feet of drift and reached the Trenton at 925 feet. Wells abandoned are located in Section 12, 2 wells; Section 15, 1 well; Section 18, 1 well; Section 26, 1 well; Section 30, 3 wells.

Howard Township. The Templin well passed through 80 feet of drift and reached the Trenton at 921 feet. The Weaver well passed through 100 feet of drift and reached the Trenton at 921 feet. A well drilled on the Underwood place in Section 15 was abandoned in 1913.

Harrison Township. A well located on the property of Jackson Morrow in Section 13 and one on the property of Mary A. Frances were abandoned in 1912 and 1913.

HUNTINGTON COUNTY

The Niagara limestone underlies the glacial drift in this County. The surface of the limestone has been deeply eroded and the drift varies much in thickness. Outcrops of the limestone occur along the banks of the Salamonie River. The southern part of this County has been good oil territory in the past and the field has been extended slightly recently. The County lies on the north side of the Arch and the strata dip toward the north. Structural conditions can be determined only by subsurface work.

The following are the records of some of the wells that have been drilled in this County:

Jefferson Township: Sections 7, 8, 17 and 18 were all productive territory in 1905. The following wells have been abandoned: Section 7, 2 wells; Section 13, 2 wells; Section 19, 3 wells; Section 21, 6 wells; Sec-

tion 24, 1 well; Section 28, 7 wells; Section 31, 11 wells; Section 33, 27 wells; Section 34, 10 wells; Section 35, 13 wells; Section 36, 8 wells.

Salamonie Township. 25 new wells were drilled in this Township in 1905, which was formerly known as salt water territory. All were good producing wells.

An average record of the bores on the S. E. ¼ showed:

Drive pipe	58 feet.
Casing	385 "
Top of Trenton	1007 "
Total depth	1087 "

March Petroleum Co. Mill Lot Well No. 1. Located S. E. ¼ of Section 20, Salamonie Township:

Drive pipe	77 feet.
Casing	406 "
Top of sand	978½ "
Drilled in sand	29 "
Total depth	1007½ "

Shot with 100 quarts April 4, 1919.

Pumped 50 barrels oil first 24 hours.

J. L. Priddy Lease No. 9. N. W. ¼ of Section 20, Salamonie Township:

Drive pipe	52 feet. 10″
Casing	428 "
Top of sand	1007 "
Drilled in sand	30 "
Total depth	1037 "

Not shot, plugged April 11, 1919.

Calvin Perdue Lease No. 3, S. E. ¼ of Section 29:

Drive pipe	72 feet.
Casing	425 "
Top of sand	960 "
Drilled in sand	22 "
Total depth	982 "

Shot with 60 quarts April 11, 1919.

Pumped 125 barrels first 24 hours.

Calvin Perdue Lease No. 4. S. E. ¼ of Section 29, Salamonie Township:

Drive pipe	61½ feet.
Casing	432 "
Top of sand	975 "
Drilled in sand	32 "
Total depth	1007 "

Shot with 100 quarts. Pumped first 24 hours, 50 barrels.

Calvin Perdue Lease No. 5. S. E. ¼ of Section 29:

Drive pipe	89 feet.
Casing	432 "
Top of sand	956 "
Drilled in sand	25½ "
Total depth	981½ "

Shot 80 quarts. Pumped 70 barrels first 24 hours.

Calvin Perdue Lease No. 6. S. E. ¼ of Section 29:

Drive pipe	91	feet.
Casing	400	"
Top of sand	968	"
Drilled in sand	24	"
Total depth	992	"

Shot with 80 quarts. Pumped 55 barrels first 24 hours.

Calvin Perdue Lease No. 7. S. W. ¼ of Section 29:

Drive pipe	32	feet.
Casing	417	"
Top of sand	952	"
Drilled in sand	32	"
Total depth	975	"

Shot with 80 quarts. Pumped 150 barrels 24 hours.

Calvin Perdue Lease No. 8. N. E. ¼ of Section 29:

Drive pipe	44	feet.
Casing	407	"
Top of sand	976	"
Drilled in sand	25	"
Total depth	1001	"

Shot with 120 quarts July 25, 1919. Pumped 180 barrels first 24 hours.

Calvin Perdue Lease No. 9. N. E. ¼ of Section 29:

Drive pipe	52	feet. 8"
Casing	508	"
Top of sand	975	"
Drilled in sand	28	"
Total depth	1003	"

Shot with 140 quarts August 6, 1919. Pumped 90 barrels first 24 hours.

Calvin Perdue Lease No. 10. S. E. ¼ of Section 29:

Drive pipe	32	feet.
Casing	420	"
Top of sand	958½	"
Drilled in sand	20	"
Total depth	978½	"

Shot with 60 quarts August 9, 1919.

Calvin Perdue Lease No. 11. N. E. ¼ of Section 29:

Drive pipe	44	feet. 2"
Casing	400	"
Top of sand	968	"
Drilled in sand	222	"
Total depth	990	"

Shot with 100 quarts. Pumped 45 barrels first 24 hours.

L. S. Jones Lease No. 16. S. E. ¼ of Section 20:

Drive pipe	16½	feet.
Casing	412	"
Top of sand	968	"
Drilled in sand	25	"
Total depth	993	"

Shot with 80 quarts May 2, 1919.
Pumped 50 barrels first 24 hours.

Frank Malott Lease No. 1. N. E. ¼ of Section 29:

Drive pipe	33	feet.
Casing	428½	"
Top of sand	965	"
Drilled in sand	27	" 4"
Total depth	992	"

Shot with 100 quarts. Pumped 100 barrels first 24 hours.

Frank Malott, Lease No. 2, N. E. ¼ of Section 29.

Drive pipe	73	feet.
Casing	415	"
Top of sand	977	"
Drilled in sand	26	"
Total depth	1003	"

Shot with 120 quarts. Pumped first 24 hours, 90 barrels.

Frank Malott Lease No. 3, N. W. ¼ of Section 29.

Drive pipe	69	feet.
Casing	394	"
Top of sand	986	"
Drilled in sand	18	"
Total depth	1004	"

Pumped salt water first 24 hours.

Calvin Perdue Lease No. 12, N. E. ¼ of Section 29.

39 feet to limestone.
376 feet through limestone.
572 feet of shale.
22 feet of Trenton rock.
Pumped 20 barrels first 24 hours.

Calvin Perdue Lease No. 13, S. E. ¼ of Section 29.

39 feet to limestone.
363 feet through limestone.
566 feet of shale.
23 feet of Trenton rock.
Pumped 40 barrels first 24 hours. Finished Aug. 30, 1919.

Calvin Perdue Lease No. 14, N. E. ¼ of Section 29.
28 feet to limestone.
367 feet through limestone.
573 feet of shale.
24½ feet of Trenton limestone.
Pumped 140 barrels first 24 hours.

Calvin Perdue Lease No. 15, N. E. ¼ of Section 29.
31 feet to limestone.
369 feet through limestone.
586 feet of shale.
25 feet of Trenton limestone.
Pumped 25 barrels first 24 hours.

Calvin Perdue Lease Well No. 16, N. E. ¼ of Section 29.
46 feet 3 inches to limestone.
384 feet through limestone.
550 feet of shale.
24 feet of Trenton.
Pumped 110 barrels first 24 hours.

Calvin Perdue Lease Well No. 17, S. W. ¼ of Section 29.
28 feet to limestone.
287 feet through limestone.
542 feet of shale.
20 feet of Trenton.
Pumped 35 barrels first 24 hours. Finished Sept. 19, 1919.

Calvin Perdue Lease Well No. 18, N. E. ¼ of Section 29.
34 feet to limestone.
371 feet through limestone.
575 feet of shale.
25 feet of Trenton.
Water, 24 hours.

Calvin Perdue Lease Well No. 19, S. W. ¼ of Section 29.
33 feet to limestone.
384 feet through limestone.
542 feet of shale.
19 feet of Trenton.
Pumped 15 barrels first 24 hours. Finished Oct. 18, 1919.

Calvin Perdue Lease Well No. 20, N. E. ¼ of Section 29.
78 feet to limestone.
336 feet through limestone.
563 feet of shale.
20 feet of Trenton.
First 24 hours, 25 barrels. Finished Oct. 10,1919.

Calvin Perdue Lease Well No. 21, N. E. ¼ of Section 29.

56 feet to limestone.
357 feet through limestone.
578 feet of shale.
19 feet of Trenton.
First 24 hours, 20 barrels. Finished Oct. 18, 1919.

Frank Malott Lease Well No. 4, N. W. ¼ of Section 29.

58 feet to limestone.
422 feet through limestone.
503 feet of shale.
20½ feet of Trenton.
First 24 hours, 20 barrels. Finished Oct. 3, 1919.

Wayne Township. 10 wells were drilled in the west half of Section 36, in 1904 and 1905, all of which started at about 100 barrels. Well No. 5, on the Hamilton lease, S. W. ¼ of Section 25, finished August, 1905, may, except in production, be taken as an average for this territory, its record being as follows:

Drive pipe	221	feet.
Casing	512	"
Top of Trenton	1001	"
Total depth	1064	"
Initial production (barrels)	100	

Well No. 6 on the Pinkerton Lease, N. E. ¼ of Section 13, Jefferson Township had the following record:

Drive pipe	170	feet.
Casing	520	"
Top of Trenton	971	"
Total depth	1023½	"
Initial production	143	barrels.

Wells have been abandoned in this Township as follows: Section 3, 1 well; Section 11, 1 well; Section 12, 8 wells; Section 13, 9 wells; Section 22, 1 well; Section 23, 5 wells; Section 24, 15 wells; Section 27, 1 well; Section 31, 2 wells; Section 34, 10 wells; Section 35, 15 wells; Section 36, 1 well.

Monroe Wyley Lease No. 1, S. E. ¼ of Section 12.

Drive pipe	137	feet.
Casing	427	"
Top of sand	1001	"
Drilled in sand	30	"
Total depth	1031	"

No showing of oil. July, 1919.

Chas. H. Freck Lease No. 1, S. W. ¼ of Section 13.

28 feet to limestone.
417 feet through limestone.
556 feet of shale.
17 feet of Trenton.
Finished Aug. 20, 1919. Slight showing of oil, but not enough to shoot. Aug. 20. 1919.

Geo. Good Lease No. 1, N. E. ¼ of Section 32.
33 feet to limestone.
357 feet through limestone.
580 feet of shale.
19 feet of Trenton.
4 barrels first 24 hours.

Geo. Good Lease No. 2, N. E. ¼ of Section 32.
54 feet to limestone.
374 feet through limestone.
570 feet of shale.
38 feet of Trenton.
Finished Oct. 13, 1919. No showing of oil.

Well of Grant Myres, No. 1.

Surface	0	to	42	feet.
Gravel	42	"	215	"
Red rock	215	"	235	"
Slate	235	"	259	"
Lime	259	"	350	"
Slate	350	"	370	"
Lime	370	"	390	"
Slate	390	"	510	"
Shale	510	"	600	"
Brown shale	600	"	680	"
Light shale	680	"	750	"
Brown shale	750	"	900	"
Slate	900	"	992	"
Trenton rock	992	"	1002	"

Very hard, light showing of oil. Water found at 1,002 feet. Total depth 1,002 feet. Drilled by Blosser, Phipps and others.

Section 17. Well No. 1. Ed Mossburg, S. W. ¼ of S. W. ¼: 8 inch drive pipe 52 feet; 5⅝ inch casing, 437 feet. Top of sand (Trenton) 1,013 feet. Salt water at 1,032 feet. Total 1,041 feet. Plugged January 29, 1919. Elevation of mouth 821 feet. Trenton 192 feet.

Well No. 2. S. E. ¼ of S. E. ¼ of Section 17: Drive pipe 35 feet. Top of Trenton 1,027 feet. Elevation 831 feet. Trenton 196 feet.

Well No. 1, Martha A. Raugh: S. E. ¼ of Section 17. 8 inch drive pipe, 32 feet; 5⅝ inch casing, 395 feet. Top of sand, 1,027 feet. Big dose salt water at 1,050 feet. No showing of oil. Drilled June, 1918. Plugged June, 1918.

Section 20. S. E. ¼ Old Home Well No. 1: Top of Trenton, 965. Elevation 816. Trenton, 149.

No. 2, 10 rods east. Top of Trenton 979. Elevation 826. Trenton 153.

No. 3, 500 feet north of No. 2. Top of Trenton 986 feet. Elevation 826. Trenton 160.

No. 4, S. E. of No. 2 500 feet. Top of Trenton 985. Elevation 827. Trenton 158.

No. 5. S. E. of No. 4, 500 feet. Top of Trenton 983. Elevation 826. Trenton 157.

No. 6, S. E. of No. 5, 500 feet. Top of Trenton 972. Elevation 816. Trenton 156.

No. 7, S. E. of No. 6, 500 feet. Top of Trenton 979. Elevation 827. Trenton 152.

No. 8, north of No. 7, 500 feet. Top of Trenton 982. Elevation 828. Trenton 154.

No. 9, north of tanks near No. 1, not drilled. Elevation 827.

Well No. 14. L. S. Jones, south half of N. E. ¼, Section 20: 8 inch drive pipe, 58 feet; 5⅝ inch casing, 412 feet. Top of sand 990 feet. Total depth, 1,015 feet. Drilled 25 feet in sand. Shot 80 quarts. First 24 hours, 30 barrels. Drilled February 21, 1919.

Well No. 7. J. L. Priddy. S. E. corner of N. W. ¼, Section 20. 8 inch drive pipe 28 feet; 5⅝ inch casing, 412 feet. Top of sand 988 feet. Total depth, 1,007 feet. In sand 19½ feet. Shot 100 quarts. Production first 24 hours, 24 barrels. Drilled January, 1919.

Well No. 8. J. L. Priddy. S. E. corner of N. W. ¼ of Section 20. 8 inch drive pipe, 64 feet; 5⅝ inch casing, 400 feet. Top of sand 990 feet. Total depth 1,015 feet. Drilled 25 feet in sand. Shot 80 quarts. First 24 hours, 30 barrels. Drilled February 21, 1919.

Well No. 15, L. S. Jones, S. ½ of N. E. ¼ of Section 20. 8 inch drive pipe, 72 feet; 5⅝ inch casing, 400 feet. Top of sand 983 feet. Total depth 1,003 feet. 20 feet in sand. Drilled February, 1919. Production first 23 hours, 40 barrels. Elevation of mouth 837 feet.

Well No. 3. J. L. Priddy, S. ½ of N. W. ¼, 8 inch drive pipe, 52 feet; 5⅝ inch casing, 424 feet. Top of sand 1,007 feet. First pay 10 feet. Total depth, 1,029 feet. Drilled September, 1918.

Well No. 8. L. S. Jones, S. ½ of N. E. ¼ of Section 20. 8 inch drive pipe, 62 feet; 5⅝ inch casing, 425 feet. Sand at 1,007 feet. Total depth, 1,027 feet. Drilled August, 1918. Production 24 hours, 20 barrels.

Section 20. Well No. 10. L. S. Jones, S. ½ of N. E. ¼ of section 20; 8 inch drive pipe 75 feet 10 inches—5 5/8 casing 415 feet. Top of sand 1006 feet. Bottom of sand 1027 feet. Drilled Oct. 3, 1918. Production first 24 hours 22 barrels.

Well No. 4. J. L. Priddy, S. ½ of N. W. ¼; 8 inch drive pipe 62 feet, 5 5/8 casing 425 feet. Top of sand 987 feet. Total depth 1017 feet. Showing of oil 7 feet in sand. Second pay 22 feet in. Drilled October, 1918. Produced 45 barrels first 24 hours.

Well No. 11. L. S. Jones, N. E. ¼; 8 inch drive pipe 72 feet, 5⅝ casing 400 feet. Top of sand 997 feet. Total depth 1034 feet. In sand 27 feet. Shot Oct. 21, 1918.

Well No. 12. L. S. Jones, N. E. ¼; 8 inch drive pipe 71 feet, 5⅝ casing 425 feet. Top of sand 1007 feet. Total depth 1029 feet. In sand 22 feet. Production first 24 hours 12 barrels.

Well No. 13. L. S. Jones, N. E. ¼ of section 20; 8 inch drive pipe 58 feet, 5⅝ casing 415 feet. Top of sand 995 feet, 22 feet in sand. Drilled Nov. 30, 1918.

Well No. 5. J. L. Priddy, S. ½ of N. E. ¼; 8 inch drive pipe 91 feet, 5⅝ casing 405 feet. Top of sand 986 feet. Pay 14 feet in sand. Depth 1017 feet. Drilled 31 feet in sand. Shot 80 quarts. Production first 24 hours 60 barrels.

Well No. 6. J. L. Priddy, S. ½ of N. E. ¼; 8 inch drive pipe, 117 feet 6 inches—5⅝ casing 401 feet. Top of sand 982 feet. Total depth 1007 feet. Drilled 25 feet in sand.

Well No. 6. L. S. Jones, S. W. ¼ section 20; 8 inch drive pipe 56 feet, 5⅝ casing 425 feet. Top of sand 991 feet. Total depth 1018 feet. In sand 27 feet. Showing of oil 10 feet in. Pay at 24 feet in. Shot July 17, 1918.

Well No. 1. J. L. Priddy, N. ½ of N. W. ¼. Drive pipe 68 feet, 5⅝ casing 418 feet. Top of sand 989 feet. Bottom 1022 feet. First pay 10 feet in. Second pay 28 feet in sand. Shot July 22, 1918. Production first 24 hours 80 barrels.

Well No. 7. L. S. Jones, S. E. ¼. Drilled in Aug. 9, 1918. Top of sand 994 feet. Drilled 27 feet in sand. Total depth 1021 feet; 8 inch drive pipe 57 feet, 5⅝ casing 425 feet. Production first 24 hours 20 barrels.

Well No. 2. J. L. Priddy, S. ½ of N. W. ¼; 8 inch drive pipe 70 feet, 5⅝ casing 425 feet. Top of sand 991 feet. Total depth 1024 feet, first pay 8 feet in. All pay. Shot Aug. 23, 1918. 100 quarts. Production first 24 hours 145 barrels.

Well No. 9. L. S. Jones, S. E. ¼; 8 inch drive pipe 70 feet 3 inches—5⅝ casing 423 feet. Top of sand 991 feet. Total depth 1019 feet. Pay at 19 feet. In sand 28 feet. Completed Sept. 6, 1918. Production first 24 hours 50 barrels.

Well No. 1. L. S. Jones, N. E. ¼ section 20; 8 inch drive pipe 25 feet 5 inches, 6¼ casing 404 feet 1 inch. Top of sand 987 feet. First pay at 991 feet. Total depth 1005 feet.

Well No. 2. L. S. Jones, S. E. ¼; 8 inch drive pipe 29 feet, 6¼ casing 402 feet. Top of sand 978 feet. Pay sand 14 feet. Total depth 1006 feet. Elevation of mouth 831 feet.

Well No. 3. L. S. Jones, S. E. ¼; 8 inch drive pipe 47 feet—5⅝ casing 415 feet. Top of sand 990 feet. First pay 4 feet in sand. Total depth 1016 feet. Elevation of mouth 841 feet.

Well No. 4. L. S. Jones, S. E. ¼; 8 inch drive pipe 58 feet—5⅝ casing 415 feet. Top of sand 990 feet. First pay 2 feet in. Total depth 1010 feet.

Well No. 5. L. S. Jones, S. E. ¼; 8 inch drive pipe 47 feet, 5⅝ casing 414 feet. Top of sand 988 feet. First pay at 12 feet in sand. Show of oil at 16 feet. Salt water at 18 feet. Total depth 1031 feet. Elevation 831 feet. Drilled 41 feet in sand. Production salt water. Plugged June 17, 1918.

Section 21. Well No. 1. Eliza P. Thompson, N. E. corner of S. W. ¼; 8 inch drive pipe 67 feet, 5⅝ casing 425 feet. Top of sand 1007 feet, 28 feet in sand. No showing of oil. Plugged November, 1918.

Section 27. Well No. 1. Raper Holmes, N. E. corner of the S. W. ¼; 8 inch drive pipe 87 feet, 5⅝ casing 420 feet. Top of sand 1023 feet. Bottom of sand 1067 feet. Show of oil 26 feet in sand, not shot. Production all salt water. Plugged June 21, 1918.

Section 28. Well No. 1. Louisa Beard, S. E. ¼; 8 inch drive pipe 32 feet, 5⅝ casing 410 feet. Top of sand 1001 feet. First pay 10 feet in. Total depth 1021 feet.

Well No. 1. A. J. Gephart, S. E. corner N. E. ¼; 8 inch drive pipe 70 feet, 5⅝ casing 425 feet. Top of sand 1007 feet. Total depth 1028 feet. In sand 21 feet. Production first 24 hours 1 barrel.

Section 29. Well No. 1. Catherine Beard, W. ½ S. W. ¼; 8 inch drive pipe 28 feet 4 inches, 6¼ casing 412 feet 10 inches. Top of sand 999 feet. Total depth 1038 feet. Pay all way along, water at 1038 feet.

Section 29. Well No. 1. Calvin Perdue, N. ½ of S. E. ¼; 8 inch drive pipe 22 feet, 5⅝ casing 405 feet. Top of sand 968 feet. In sand 25 feet. Total depth 993 feet. Drilled January, 1919. Production first 24 hours 15 barrels.

Well No. 2. Calvin Perdue, N. E. corner S. E. ¼; 8 inch drive pipe 23 feet, 5⅝ casing 404 feet. Top of sand 995 feet. In sand 32 feet. Total depth 1027 feet. No showing of oil. Drilled March, 1919. Elevation of mouth above sea level 836 feet.

Wells abandoned in this township are as follows: Section 3, 1 well; section 4, 1 well; section 12, 1 well; section 20, 1 well; section 24, 2 wells; section 25, 5 wells; section 26, 2 wells; section 29, 1 well; section 31, 13 wells; section 34, 9 wells; section 35, 4 wells; section 36, 19 wells.

JACKSON COUNTY

The bed rock in the eastern part of Jackson County belongs to the New Albany shale division of the Devonian; the remainder of the county is occupied by the Knobstone division of the Mississippian. The northwest portion lies within the unglaciated region and the remainder of the county is covered with drift varying in thickness from a few feet to more than one hundred feet. In the region not covered with glacial drift the study of structural conditions is difficult because of the absence of persistent layers of rock in the Knobstone. In the region west of Brownstown there is a layer of limestone, a ledge in the Knobstone, and an accompanying bed of sandstone, which may be used for a datum plane for the registering of the structure. Using this limestone and the sandstone, Mr. O. H. Hughes located a small terrace or shoulder which is represented on the accompanying map. It is possible that under the proper structures oil or gas may be found in the Devonian or in the Trenton in this county. The Trenton lies below the surface in the county at a depth of from 1200 to 1500 feet.

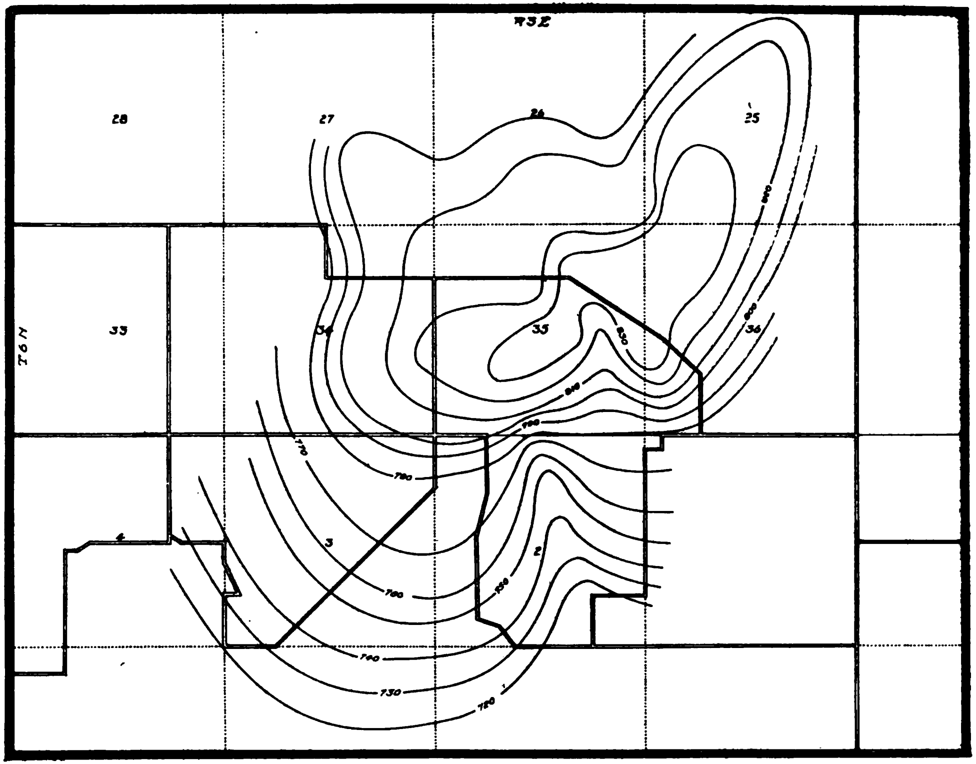

Fig. 38. Outline of a structure in Jackson County, Owen Township. Constructed from data secured by O. H. Hughes. Probably not a definite anticline but a shoulder. Key formation, a lens of limestone in the Knobstone.

The following is the record of a well drilled at Brownstown:

Section of Well No. 1.

Drift	43	feet.
Knobstone shale	275	"
Devonian shale	147	"
Corniferous and Niagara limestone	225	"
Hudson River and Utica	658	"
Trenton limestone	100	"
Total depth	1448	"

Yielded no gas but at a depth of 1371 feet a slight flow of oil was obtained.

The following is the record of a well drilled at Seymour:

Section of Well No. 1.

Drift	75	feet.
Sub-carboniferous sandstone	15	"
Devonian sandstone	115	"
Corniferous limestone	20	"
Niagara limestone	190	"
Hudson River limestone and shale	520	"
Utica shale	165	"
Trenton limestone	94	"
Total depth	1194	"

JASPER COUNTY

The northwestern extension of the Cincinnati Arch passes through this county and the strata in the southern part of the county dip in the opposite direction to those of the northern portion of the county. Differential movements in the arch have produced structures favorable to the accumulation of oil and gas. These structures occur for the most part on the north side of the arch. Since the bed rock is covered with a mantle of glacial drift ranging in thickness from five to more than one hundred feet, these structures cannot be located by surface examinations. For this reason prospecting operations have been confined to the drill. Such prospecting has not been so expensive in this county on account of the oil sand being found at shallow depths. The geological formations underlying the drift belong to the Silurian, Devonian, Mississippian, and the Pennsylvanian periods. Several small oil pools occur in this county, the oil being drawn from the Devonian strata at shallow depths. The map shows the location of these oil fields. Many of the wells indicated as producing wells have been abandoned since the map was prepared or prior to it.

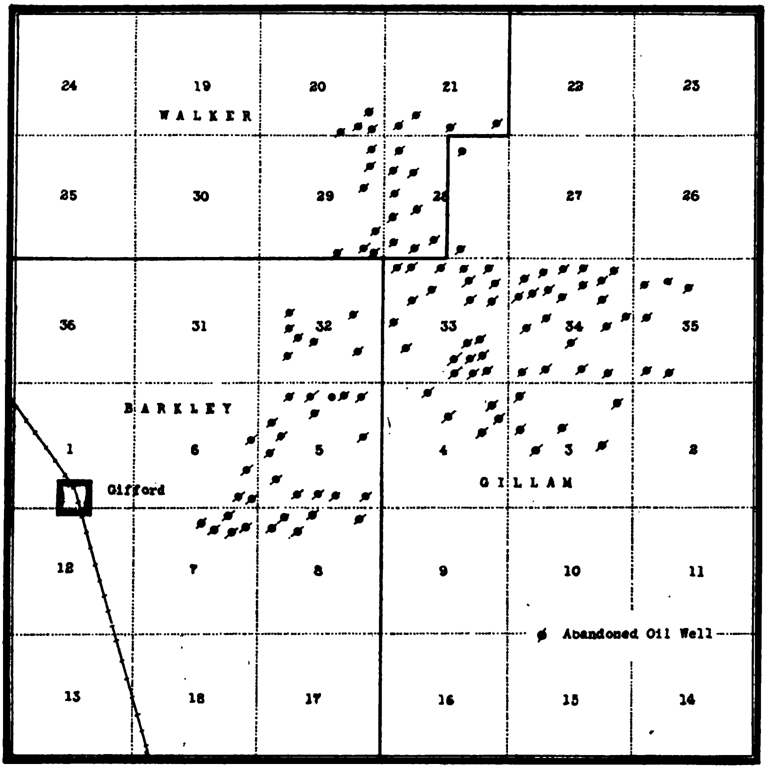

Fig. 39. Map showing location of oil wells in the Jasper County field near Gifford.

The following is the section of a well drilled at Remington[2]:

Section of Well No. 1.

Drift	5	feet.
Devonian shale	85	"
Corniferous limestone	50	"
Niagara limestone	260	"
Hudson River and Utica	570	"
Trenton limestone	295	"
Total depth	1265	"

Yielded no gas.

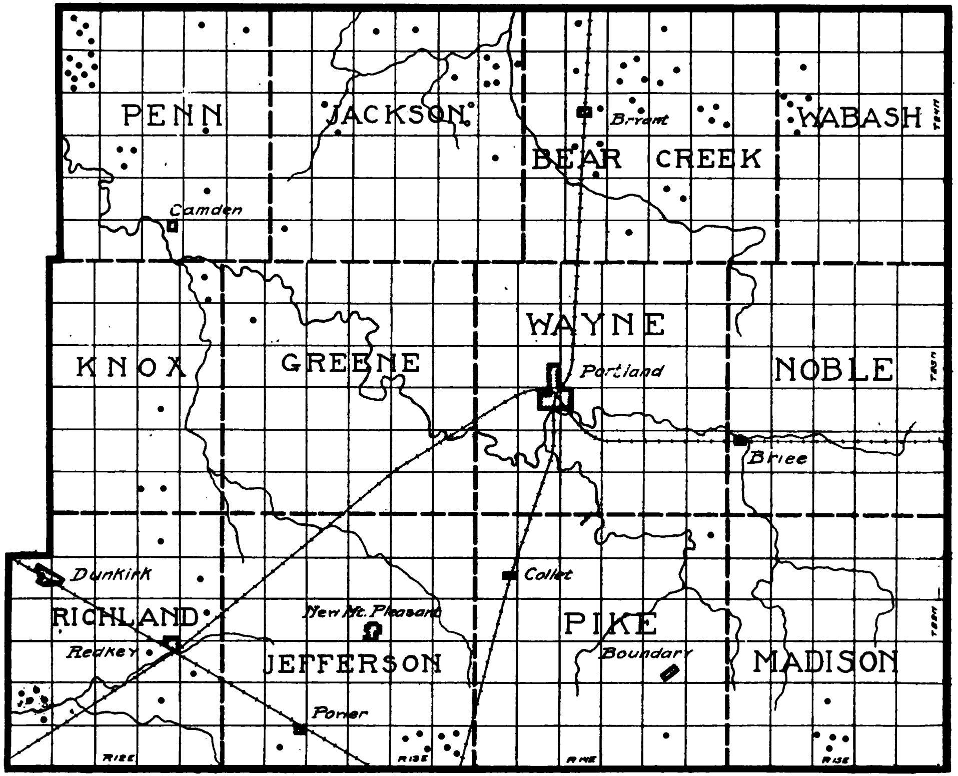

Fig. 40. Map of Jay County showing location of abandoned wells. Oil territory in the northern tier of townships. Gas in central part and in western part of Knox Township. See large map.

JAY COUNTY

The Silurian forms the bed rock in this county and outcrops along the Wabash River near the north line and on the Salamonie near Portland. The bed rock is largely concealed by the glacial drift which has a thickness of 25 to 125 feet. The general geologic conditions as represented in a well drilled at Portland are given below:

Wayne Township.

Section of Portland Well No. 1.

Drift	58	feet.
Niagara limestone	192	"
Shales	740	"
Trenton limestone	500	"
St. Peter	20	"
Total depth	1510	"

A small flow of gas and oil yielding 25 barrels a day was obtained. Five wells drilled near Portland reached the Trenton at 17, 63, 62, 67, and 71 feet below sea level. Oil was obtained from sections 5, 6, 10, 21, and 26, and gas from 5, 6, 10, 17, 21, and 22.

Richland Township. At Red Key the Trenton was reached at 900 feet and a flow of gas a few feet below the top of the Trenton resulted. At Dunkirk the Trenton was reached at 925 feet and a flow of 5,000,000 cubic feet of gas obtained. A second well reached the Trenton at 930 feet and produced a strong flow of gas at 955 feet. A section of this well is given below:

Section of Dunkirk Well.

Drift	60	feet.
Niagara limestone	230	"
Hudson River and Utica	640	"
Trenton limestone	25	"
Total depth	955	"

Oil was obtained in this township in sections 13, 16, 24, 25, 28, and 36, and gas in 9, 24, and 26. Wells have been abandoned as follows: Section 2, 1 well; section 12, 1 well; section 13, 1 well; section 23, 1 well; section 24, 1 well; section 26, 1 well; section 29, 5 wells.

Penn Township. At Camden the Trenton is reached at 935 feet and gas at 963 feet. The average depth of the drift at Camden is 35 feet and the average depth of the Trenton 925 feet. Nearly all the sections in this township have produced oil or gas or both. Wells have been abandoned in section 1, 1 well; section 2, 1 well; section 5, 4 wells; section 8, 9 wells; section 14, 1 well; section 21, 3 wells; section 26, 1 well.

Jefferson Township. Gas is reported to have been found at Coneo in this township. The following wells were drilled and plugged: Section 32, 1 well; section 35, 3 wells; section 36, 4 wells.

Greene Township. Oil was obtained in sections 8, 17, 20, and 24, and gas in 4, 5, 6, 7, 18, 19, 20, 23, 26, 28, 31, 32, 34, and 35. Wells were abandoned in section 7, 1 well.

Jackson Township. Oil was obtained in this township from sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 35, and 36. Gas was obtained in sections 7, 18, 19, 20, 21, 25, 29, 30, and 32. Wells have been plugged in section 3, 1 well; section 4, 1 well; section 11, 1 well; section 12, 5 wells; section 14, 2 wells; section 17, 2 wells; section 24, 1 well; section 31, 1 well.

Knox Township. Oil was found in sections 1, 4, 11, and gas in sections 1, 2, 25, and 36. Wells have been abandoned in section 1, 2 wells.

Pike Township. Oil was found in sections 7, 8, and 34. Wells have been abandoned in section 23, 1 well; section 35, 2 wells. Recently wells were drilled in this township as follows:

James Tharp No. 1. N. E. ¼ N. W. ¼, Section 29, Township 22 N, Range 14 E:

Mud, sand and gravel	189	feet.
Limestone	91	"
Slate and shale	800	"
In Trenton limestone	20	"
Total depth	1100	"

Grant Whitenack, No. 2. S. E. ¼, N. W. ¼, Section 28, Township 22 N., Range 14 E:

Mud, sand and gravel	137	feet.
Limestone	203	"
Slate and shale	690	"
In Trenton limestone	20	"
Total depth	1050	"

Corn. Whitenack No. 2, N. E. ¼, N. W. ¼, Section 28, Township 22 N, Range 14 E:

Mud, sand and gravel	140	feet.
Limestone	690	"
Slate and shale	691	"
In Trenton limestone	32	"
Total depth	1064	"

Wells drilled by Union Heat, Light and Power Company.

Noble Township. Oil occurred in sections 3, 4, 5, 17, and 27. Gas in sections 8 and 17.

Bear Creek Township. At Bryant the top of the Trenton is 1020 feet or 160 feet below sea level. Oil was obtained 30 feet below the top of the Trenton. The following are the records of two wells drilled on the Kuhn lease, in the southwest quarter of section 28:

	Well No. 7	Well No. 2
Drive pipe (drift)	78 feet.	104 feet.
Casing	245 "	238 "
Top of Trenton	1004 "	997 "
Total depth	1050 "	1048 "

The record of a well drilled by W. J. Heeter in section 3 is given as follows:

Drift	73	feet.
White limestone	131	"
White slate	10	"
White lime	20	"
Slate (shale)	30	"
Limestone	15	"
Slate	40	"
Blue lime	5	"
White slate	75	"
Blue lime	10	"
White slate	305	"
Brown shale	300	"
Black slate	12	"
Trenton rock	50	"
Total depth	1081	"

Showing of oil at 20 feet in Trenton.
Salt water, strong flow.

Oil was obtained in sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 21, 24, 30, and 31, and gas in sections 14, 18, 19, 22, 26, 27, 29, 30, 31, and 34. Wells have been plugged in section 3, 1 well; section 5, 1 well; section 8, 1 well; section 9, 4 wells; section 10, 2 wells; section 14, 4 wells; section 16, 2 wells; section 17, 1 well; section 20, 3 wells; section 26, 2 wells; section 27, 2 wells; section 33, 1 well.

Wabash Township. Oil was found in sections 3, 4, 5, 6, 7, 8, 17, 18, 19, and 32; gas in 19. Wells have been plugged in section 7, 1 well; section 18, 5 wells.

Well No. 2, Bon Macy Farm.

Gravel, sand and mud	50	feet.
Limestone	200	"
Slate and limestone	300	"
Slate	300	"
Brown shale	150	"
Gray shale	25	"
Top of Trenton	1025	"
Into Trenton	45	"

Madison Township. Wells have been drilled at various points in this township. Four wells were drilled and abandoned in section 33 and 1 in section 28.

JEFFERSON COUNTY

The strata which outcrop in Jefferson County belong to the Ordovician, Silurian, Devonian and Quaternary periods. The subdivisions as given by Cumings, Siebenthal and others are given in the following outlines:

Quaternary	Recent—clays and alluvium	
	Pleistocene—sand gravels and till	
Devonian	New Albany—shales	
	Sellersburg—limestone	
	Silver Creek—limestone	
	Jeffersonville—limestone	
Silurian	Louisville—limestone	
	Waldron—shale	
	Laurel—limestone	
	Osgood—limestone and shale	
	Brassfield—shales	
Ordovician	Richmond—shales	Elkhorn Whitewater Saluda Liberty Waynesville Arnheim
	Marysville—shales	Mt. Auburn Corryville Bellevue Fairmount Mt. Hope
	Eden—shales	McMicken Southgate Economy Fulton

The Quaternary covering in this county varies in thickness from a few feet to fifty feet. Sufficient outcrops of the bed rock may be obtained to determine the structure. Probably the best key horizon for the west part of the county will be the contact between the Sellersburg limestone and

the New Albany shale. Farther east the Laurel or the Louisville limestone might be used. Some gas has been obtained from near Foltz in the Niagara limestone. These wells were reported to have a pressure of 20 pounds in 1914.

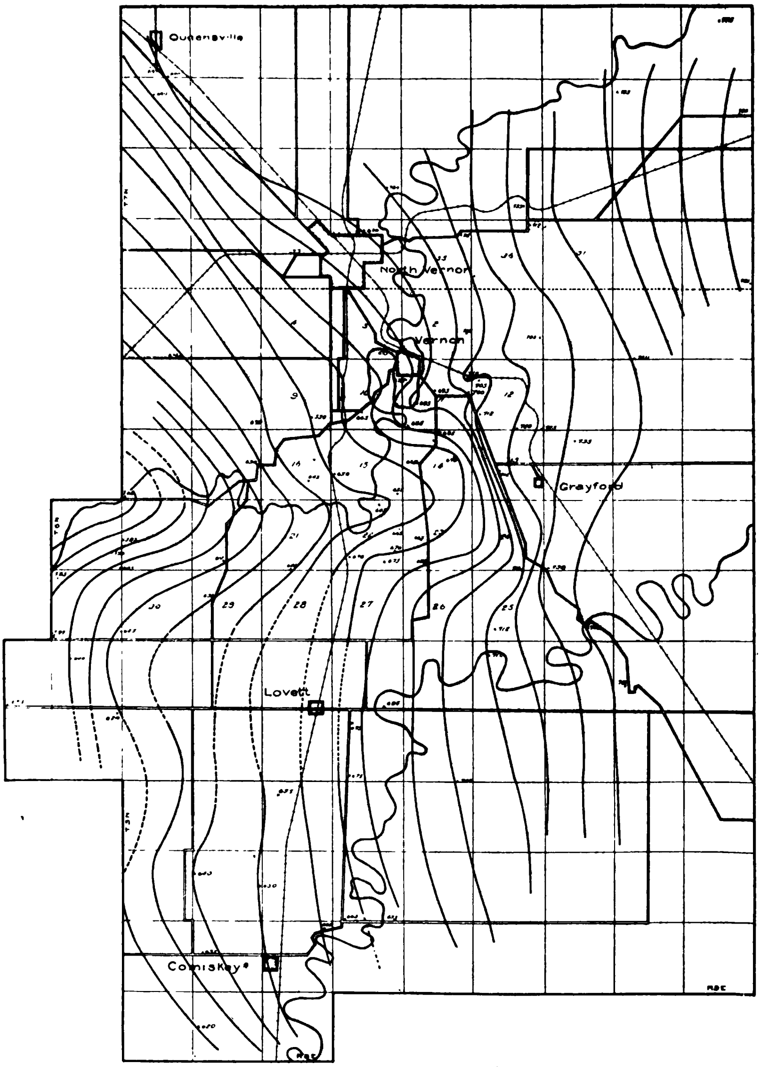

Fig. 41. Map of a portion of Jennings and Jefferson Counties showing structural contours drawn on the contact of the Sellersburg limestone and New Albany shale. Data collected by C. A. Malott and P. B. Stockdale.

JENNINGS COUNTY

The strata which outcrop in Jennings County are given in the table below:

Quarternary	Recent—residual clays and alluvium Pleistocene—gravels, sand and till
Devonian	New Albany—shales Sellersburg—limestone Silver Creek—limestone Jeffersonville—limestone
Silurian	Louisville—limestone

The Devonian and the Silurian strata are largely concealed by the surficial deposits of drift and alluvium, but enough outcrops have been obtained to enable the construction of a structural map covering a large part of the county. See page 156. The field work in the preparation of the map was done by Dr. C. A. Malott and P. B. Stockdale, members of the field party of 1919.

Gas has been obtained at North Vernon in wells drilled on structure, though perhaps not on the best part of it. A record of one of the wells is given below[2]:

Section of Well No. 1.

Surface clay	11	feet.
Corniferous limestone	28	"
Niagara limestone	252	"
Clinton (?) limestone	29	"
Hudson River limestone	440	"
Utica shale	220	"
Trenton limestone	470	"
Total depth	1450	feet.
Trenton below sea level	253	"

Yielded medium flow of gas.

JOHNSON COUNTY

The subsurface rocks of Johnson County consist of the New Albany black shale, which occupies the eastern portion of the county and the Knobstone group occupying the western part. The surface is covered with glacial drift.

A well drilled in Ninevah Township about nine miles south of Franklin reached the Trenton at 1273 feet; the first 60 feet of the Trenton was porous and contained a showing of oil. It was a wildcat well drilled

without any reference to structure. The Trenton was passed through at 1820 feet, showing 547 feet of Trenton at this point.

The Trenton limestone was reached in the southeastern part of the county at 987 feet; in the central part at 1042 feet, and in the north central part at 1220 feet.

The following are the records of some of the wells drilled in the county:

Vandivin Well No. 1, Section 9, Nineveh Township.

Drift	to	16	feet.
Sandy lime	"	33	"
Gray shale	"	285	"
Slate	"	295	"
Red rock	"	327	"
Sandy lime	"	335	"
Brown shale	"	425	"
Jeffersonville lime	"	702	"
Gray shale	"	704	"
Brown lime	"	745	"
Gray shale	"	750	"
Gray lime	"	795	"
Slate	"	953	"
Dark brown lime	"	977	"
Slate	"	982	"
Gray lime	"	1017	"
Slate	"	1022	"
Gray lime	"	1072	"
Slate	"	1077	"
Gray lime	"	1082	"
Slate	"	1097	"
Brown lime	"	1105	"
Gray lime	"	1107	"
Slate	"	1273	"
Trenton rock	"	1830	"

This well showed some oil in the first 15 feet of Trenton rock.

Mullindore Well No. 1, Section 3, Nineveh Township.

Drift	to	34	feet.
Gravel	"	37	"
Hardpan	"	65	"
Gray shale	"	100	"
Gray lime	"	105	"
Gray shale	"	160	"
Lime	"	165	"
Brown shale	"	261	"
Jeffersonville lime	"	440	"
Gray shale	"	445	"
Gray lime	"	482	"
Gray shale	"	487	"

Gray lime	to	531	feet
Gray shale	"	765	"
Slate	"	843	"
Gray lime	"	848	"
Utica shale, dark gray	"	1129	"
Trenton rock	"	1164	"

Drilled 28 feet in the Trenton. Small showing of oil in the first five feet of the rock.

A well drilled at Franklin was reported by Dr. D. A. Owen as follows:

Drift	170	feet.
Black shale	34	"
Blue and gray limestone	71	"
Sandstone	27	"
Blue shale (upper Niagara)	23	"
Gray and white limestone	120	"
Greenish blue shale varying to black	597	"
Trenton limestone	71	"
Total depth	1113	feet.
Altitude of well	736	"

A well drilled in the southeastern part of the county at Edinburg is reported as follows:

Drift	115	feet.
Shale	20	"
Limestone	220	"
Shale	622	"
Trenton limestone	500	"
Shale	83	"
White sandstone	10	"
Total depth	1580	feet.
Altitude of well	670	"

A well was drilled at Greenwood the record of which is as follows:

Drift	210	feet.
Black shale	90	"
Limestone	280	"
Whitish shale	40	"
Gray shale	300	"
Dark Utica shale	300	"
Trenton limestone	55	"
St. Peter's sandstone	200	"
Lower Magnesian limestone.		

KNOX COUNTY

This county lies in the area occupied by the strata of the Pennsylvania division, but these bed rock strata are covered with a mantle of glacial drift and alluvium which varies in thickness from twenty-five to more than one hundred feet, so that the determination of structure by direct observational methods is not possible. Subsurface work will depend upon the amount of data secured from well records. To secure a sufficient number of such records will require a large amount of wild cat drilling. A well drilled about eight miles south of Vincennes has produced some oil and the prospects of the extension of favorable structures north of the Gibson County line are encouraging. It may be possible, by using data from coal mines, wells, etc., to outline the structure on some of the coals.

Washington Township. A well drilled in the southeast quarter of section 30 reached a dry sand at 1252 feet.

Decker Township. A well was drilled on the property of J. Cunningham in section 12 and plugged in 1912. No record of the well has been obtained.

Record of Bore Northeast of Vincennes.

Drive pipe to bed rock	to	45	feet.
Yellow sandstone	"	80	"
Slate and shale	"	195	"
Sandstone, limestone and shale	"	335	"
Coal	"	340	"
Blue limestone	"	350	"
Light shale	"	360	"
Soapstone	"	390	"
Limestone	"	425	"
Light shale	"	435	"
Sandstone	"	465	"
Slate and shale	"	485	"
Fire clay	"	505	"
Blue shale	"	520	"
Limestone	"	525	"
Blue slate	"	545	"
Black shale	"	565	"
Sandstone	"	580	"
Soapstone	"	590	"
Slate	"	625	"
Limestones and slates	"	640	"
White sandstone and salt water	"	670	"
Slate and shale	"	700	"
Blue limestone	"	702	"
Soapstone and shale	"	785	"
White sandstone and salt water	"	800	"
Sandstone	"	815	"
Sandstone and shale alternately	"	940	"
Limestone	"	950	"

Black slate	to 980	feet
Sandstone	" 1000	"
Slate	" 1020	"
Streaks of slate and limestone	" 1130	"
Sandstone	" 1180	"
Shale	" 1200	"
Sandstone	" 1292	"
Shale	" 1298	"
Gray limestone	" 1310	"
Shale	" 1315	"
Soapstone	" 1325	"
Shale	" 1335	"
Blue limestone	" 1340	"
White sandstone	" 1365	"
Shale	" 1375	"
Blue limestone	" 1385	"
Slate	" 1400	"
Red rock	" 1410	"
Sandstone and salt water	" 1430	"
Shale (cased)	" 1535	"
Gray limestone	" 1655	"
Shale	" 1660	"
Blue limestone	" 1665	"
Slate and shale	" 1690	"
Sandstone and sulphur water	" 1740	"
Slate	" 1750	"
Shale	" 1755	"
Gray limestone	" 1765	"
Shale and gray limestone	" 1820	"
Bed rock	" 1825	"
Hard gray limestone	" 1840	"
Soapstone	" 1845	"
Gray limestone	" 1850	"
Soapstone	" 1860	"

Vincennes Artesian Salt Well

Sand and gravel	80	feet.
Sandstone	18	"
Soapstone	100	"
Hard pebble rock	10	"
Sandy shale	15	"
Soapstone	32	"
Blue sandstone	35	"
Sandy shale	20	"
Soapstone	10	"
Coal	3	"
Soapstone	18	"
Coal	5	"
Soapstone	18	"

Black shale	41	feet
Soapstone	138	"
Coal	5	"
Limestone	10	"
Blue shale	27	"
Black slate	30	"
Soapstone and shale	80	"
Sandstone	15	"
Slate and soapstone	75	"
Sandstone and salt water	25	"
Slate and shale	95	"
Sandstone	175	"
Shale and black slate	140	"
Sandstone	96	"
Total depth	1336	"

Well No. 1 on the Geo. Ryan farm, 200 feet N., 200 feet to west line. Section 36, Twp. 2N., R. 11 W. Knox County. Oct. 8, 1919. Well plugged and abandoned.

Soil	to	6	feet.
Gravel	"	10	"
Slate, white	"	175	"
White lime	"	179	"
Slate, black	"	185	"
White lime	"	195	"
Slate	"	310	"
Lime	"	315	"
Slate	"	340	"
Lime	"	343	"
Slate	"	360	"
Sand	"	480	"
Slate	"	500	"
Sand	"	540	"
Black slate	"	600	"
Sand	"	624	"
Black slate	"	635	"
White slate	"	655	"
Black slate	"	673	"
Lime	"	675	"
White slate	"	710	"
Black slate	"	716	"
Lime	"	746	"
Black slate	"	775	"
Lime	"	781	"
White slate	"	840	"
Sand	"	865	"
Slate, black, soft	"	900	"
Lime	"	904	"

Slate	to 960 feet
Sand	" 1060 "
Slate	" 1080 "
Lime	" 1100 "
Slate	" 1120 "
Sand, hole full of water	" 1145 "
Black slate	" 1195 "
Sand	" 1215 "
White slate	" 1220 "
Lime, hard	" 1222 "
Slate	" 1310 "
Sand	" 1350 "
Lime, hard	" 1365 "
Slate	" 1370 "
Sand, hard	" 1395 "
Slate	" 1400 "
Lime	" 1405 "
Sand	" 1440 "
Lime, hard	" 1442 "
Slate	" 1460 "
Sand	" 1466 "
Slate	" 1485 "
Sand	" 1545 "
Lime	" 1551 "
Slate	" 1558 "
Lime	" 1564 "
Slate	" 1600 "
Lime	" 1615 "
Slate	" 1635 "
Red rock	" 1643 "
Lime	" 1648 "
Sand	" 1653 "
Slate	" 1675 "
Sand, hole full of water	" 1727 "
Slate	" 1735 "
Lime	" 1753 "
Slate	" 1759 "
Sand	" 1772 "
Slate	" 1777 "
Brown lime	" 1808 "
Lime	" 1814 "
Sandy lime, oil	" 1818 "
Sand	" 1824 "
Red rock	" 1827 "
Lime	" 1838 "
Sand	" 1850 "
Lime	" 1868 "
Dark lime	" 1882 "

Lime shell, volites	to 1894	feet
White lime	" 1897	"
Lime, brown, hard	" 1920	"
Lime, soft	" 1930	"
Lime	" 2004	"
Total depth	" 2004	"

KOSCIUSKO COUNTY

Underlying the glacial drift which covers the surface of this county are strata of Devonian age consisting of a series of limestones and shales. The strata dip northward away from the arm of the Cincinnati Arch, which passes through Indiana. The drift attains a thickness of over two hundred fifty feet in this county.

Warsaw. The record of a well drilled at Warsaw is given below:

Drift	248	feet.
Limestone (Silurian and Devonian)	652	"
Shale (Ordovician)	487	"
Trenton limestone	50	"
Total depth	1437	feet.
Altitude of well	815	"

Syracuse. The record of a well drilled at Syracuse on the property of the Sandusky Cement Company was furnished the writer by Mr. S. B. Newberry, President of the company. The record of the well shows sixty-three feet of New Albany (Devonian) shale underlying the drift. The well probably ended in the Jeffersonville limestone of the Devonian. By consulting the Warsaw well record above, it will be seen that the total thickness of the Devonian and the Silurian limestone is recorded as being 652 feet. In the Elkhart well the New Albany shale has a thickness of 215 feet, which is to be expected as it is down in the basin north of the arch. The well stopped in limestone at sixty-five feet. From the evidence of these wells the Devonian limestone is thicker here than in the southern part of Indiana.

Sand, gravel, clay and boulders	278	feet.
Gray and dark shale	63	"
Gray argillaceous limestone	42	"
Crystalline gray and white limestone showing oil	20	"
Total	403	feet.

341-351 feet	Carbonate of lime	51.40
	Carbonate of magnesia	11.93
	Insoluble	32.40

351-361 feet	Carbonate of lime	72.00
	Carbonate of magnesia	7.73
	Insoluble	17.50
361-371 feet	Carbonate of lime	66.60
	Carbonate of magnesia	9.24
	Insoluble	21.24
371-381 feet	Carbonate of lime	48.60
	Carbonate of magnesia	8.57
	Insoluble	37.87

This appears to be similar to the cement rock of southeastern Indiana, but of much greater thickness than recorded in that region.

381-390 feet	Carbonate of lime	71.60
	Carbonate of magnesia	23.52
	Insoluble	3.36
392-403 feet	Carbonate of lime	75.40
	Carbonate of magnesia	19.32
	Insoluble	2.00

LAGRANGE COUNTY

Glacial drift occupies the surface of this county to a depth probably varying in thickness from 100 to 200 feet. The bed rock formations consist of strata belonging to the Devonian and the Mississippian periods. As these formations lie to the north of the Indiana extension of the Cincinnati arch they dip toward the north.

On account of the covering of the glacial drift the structural conditions of the bed rock cannot be determined by surficial observation. The possibility of oil and gas accumulations are connected with the possible occurrences of terraces, or small anticlines in the strata of the northward dipping formations. These can be located by means of well records only.

LAKE COUNTY

Silurian and Devonian strata underlie the glacial drift in this county. Because of the overlying mantle of drift stratigraphical and structural conditions of the bed rock are difficult to determine. At Crown Point the Trenton lies 919 feet below the surface, south of this point it should be encountered nearer the surface for points of the same or less elevation than Crown Point. At the north it will be found to lie deeper as the strata dip to the north.

Center Township. The following is the record of the well at Crown Point:

Drift	176 feet.
Black shale	76 "
Limestone	433 "
Bluish green shale	55 "
Clinton limestone	37 "
Bluish green Hudson River shale	122 "

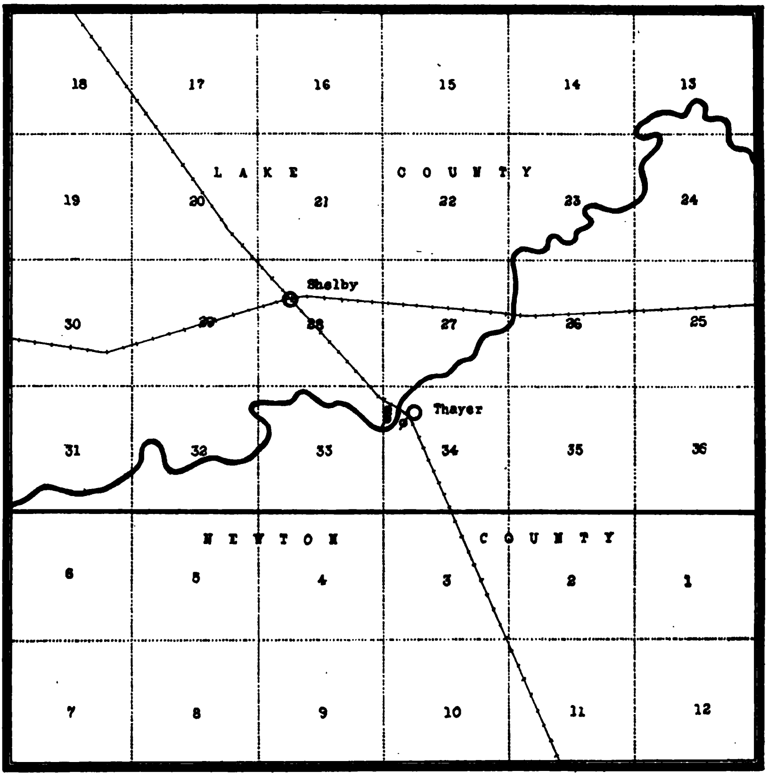

Fig. 42. Map of a portion of Lake and Newton Counties showing the location of the Thayer oil field.

Trenton limestone	342	feet
White limestone (sandy)	89	"
Limestone	15	"
Total depth	1365	"
Altitude of well	736	"
Trenton below sea level	183	"

West Township. The following is the record of a well drilled on the farm of Martin Driscoll, section 23, T. 33 N., R. 9 E., Lake County:

Drift	73 feet.			
Gray limestone	73	to	598	feet.
Red shale	598	"	607	"
Green-gray slate	607	"	640	"
Shelly limestone	640	"	705	"
Limestone	705	"	715	"
Limestone with salt water	715	"	735	"

Dark gray limestone	735 to 795 feet
Slate	795 " 850 "
Dark gray limestone	850 " 870 "
Hard white limestone	870 " 890 "
Gray limestone	890 " 1025 "
Trace of oil	905 feet.
Good showing of oil	925 "
Total depth	1025 "

Well plugged August 18, 1914.

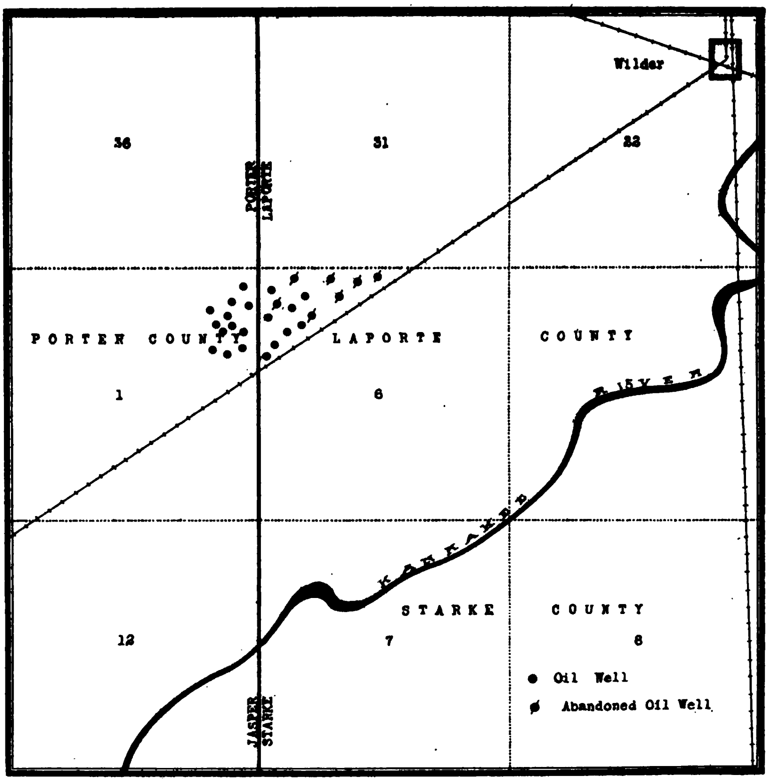

Fig. 43. Map showing the location of oil wells in the Wilder oil field on the border between Laporte and Porter Counties.

LAPORTE COUNTY

Underlying the glacial drift in this county are strata of Devonian age. The drift attains a thickness of three hundred feet or more. The dip of the bed rock is toward the north. The drift at Laporte has a thickness of 295 feet and overlies black shale. At Michigan City the drift is 250 feet thick and overlies limestone.

Michigan Township. The drift varies from 170 to 250 feet and overlies black shale and limestone at Michigan City.

Center Township. A deep well drilled at Laporte contained the following section:

Drift	295	feet.
Black shale	125	"
Shale and limestone	460	"
Limestone	500	"
Trenton limestone	520	"
St. Peter and Low. Magnesian	600	"
Potsdam sandstone	323	"
Total depth	2823	"

Galena Township. A deep well was drilled on the property of O. L. Sutherland two miles east of Reason in section 2. No record was obtained of this well. It was plugged in 1911.

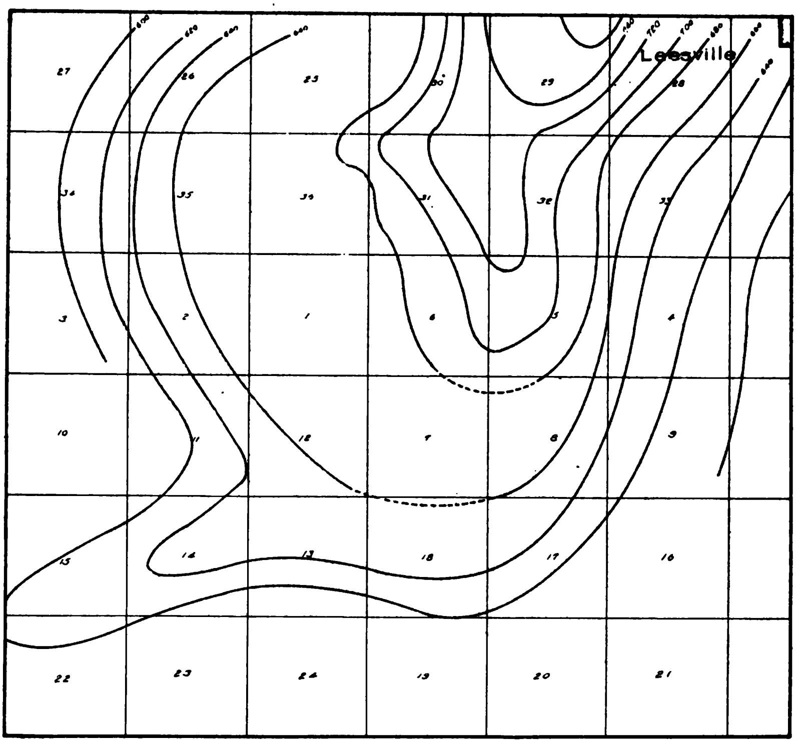

Fig. 44. Structural map of a portion of Lawrence County.

LAWRENCE COUNTY

Geology. A small portion of the surface in the eastern part of the county is occupied by the Knobstone, the remainder by the Harrodsburg limestone, the central portion by the Salem and the Mitchell limestone and the western portion by the Chester formations and the Pottsville.

Structure. The presence of the Mount Carmel fault and the Heltonville fault in the eastern part of the county produce a fold extending in a general north and south direction parallel to these faults. A change in direction of the Mt. Carmel fault at Leesville produces an anticlinal area southwest of Leesville which has been productive of gas and has to date produced a showing of oil in the Corniferous. The wells which have been drilled have not gone to the Trenton. In the neighborhood of Heltonville three wells have been drilled and a small amount of gas and oil obtained. These wells are located near the fold produced by the down throw of the strata, but the structure seems not to have been considered.

Heltonville Well. In 1913 the Bedford Oil and Gas Company drilled three wells near Heltonville. One of these wells was drilled to a depth of 1707 feet, entered the Trenton at 1633 feet and encountered a showing of oil at about 1675 feet.

Record of Heltonville Well.

	Thickness	Depth
Surface soil, etc	15 feet.	
Shale (knobstone)	85 "	100 feet.
Limestone (lense in Knobstone)	60 "	160 "
Sand (7 feet of oil sand)	20 "	180 "
Shale	10 "	190 "
Shale (white)	310 "	500 "
Shale	100 "	600 "
Shale	40 "	640 "
Sand, gas and oil bearing	10 "	650 "
Shale	50 "	700 "
Limestone	15 "	715 "
Shale	38 "	753 "
Oil sand	3 "	756 "
Limestone (water)	334 "	1090 "
Shale	543 "	1633 "
Trenton limestone	74 "	1707 "

The following is a record of Easton Well No. 1 drilled in the same township:

Easton No. 1 Well. Pleasant Run Township

Drift	20 feet.
Gravel	5 "
Lime	5 "
Shale	75 "
White mud	150 "
Lime	200 "

Black shale	5	feet	
White slate	95	"	
Brown shale	40	"	
Lime	70	"	
Brown sand	15	"	Mineral water.
Lime	15	"	
Gray sand	5	"	Some gas.
White sandy lime	5	"	
Blue lime	90	"	
Gray sand	35	"	Mineral water.
Lime	100	"	
White slate	150	"	
Lime	5	"	
Brown shale	100	"	
Broken shale with lime	50	"	
Brown shale	240	"	
Trenton at	1540	"	
Gray sand at	1620	"	No oil, 15 foot sand
Light brown sand at	1715	"	5 foot sand
Finished at	1750	"	

The second well was drilled near the first to a depth of 1100 feet and encountered a moderate flow of gas at 1090 feet. A third well was drilled about a mile south of the first two and resulted in a dry hole.

Flinn Township. Gas has been obtained from the Corniferous in this township in sections 3, 4, 5, and 28. Four of these wells were drilled by Mr. W. H. Wheitknecht and associates, and the fifth by Mr. Claude Malott. The following are brief records of the Wheitknecht wells: No. 1 is located in section 3, No. 2 in section 4, and Nos. 3 and 4 in section 28. No. 5 is in section 5.

	No. 1	No. 2	No. 3	No. 4	No. 5
Elevation above sea	587	566	709	608	570
Top of Corniferous	597	616	683	600	512
Water	635	655	714	636	550

These wells were all drilled on the east side of the structure where the strata are dipping toward the fault line. A showing of oil was found in two of the wells. These wells all started in the Knobstone and passed through four feet of Rockford Goniatite limestone and one hundred and twenty-five feet of New Albany shale and about thirty-eight feet of Devonian limestone before reaching water. A slightly different interpretation of the well records might modify the outline of the structure shown on the structural map. The elevations taken on the contact by the use of the aneroid barometer may vary slightly from the true elevations but probably not enough to make a serious change in the structural map.

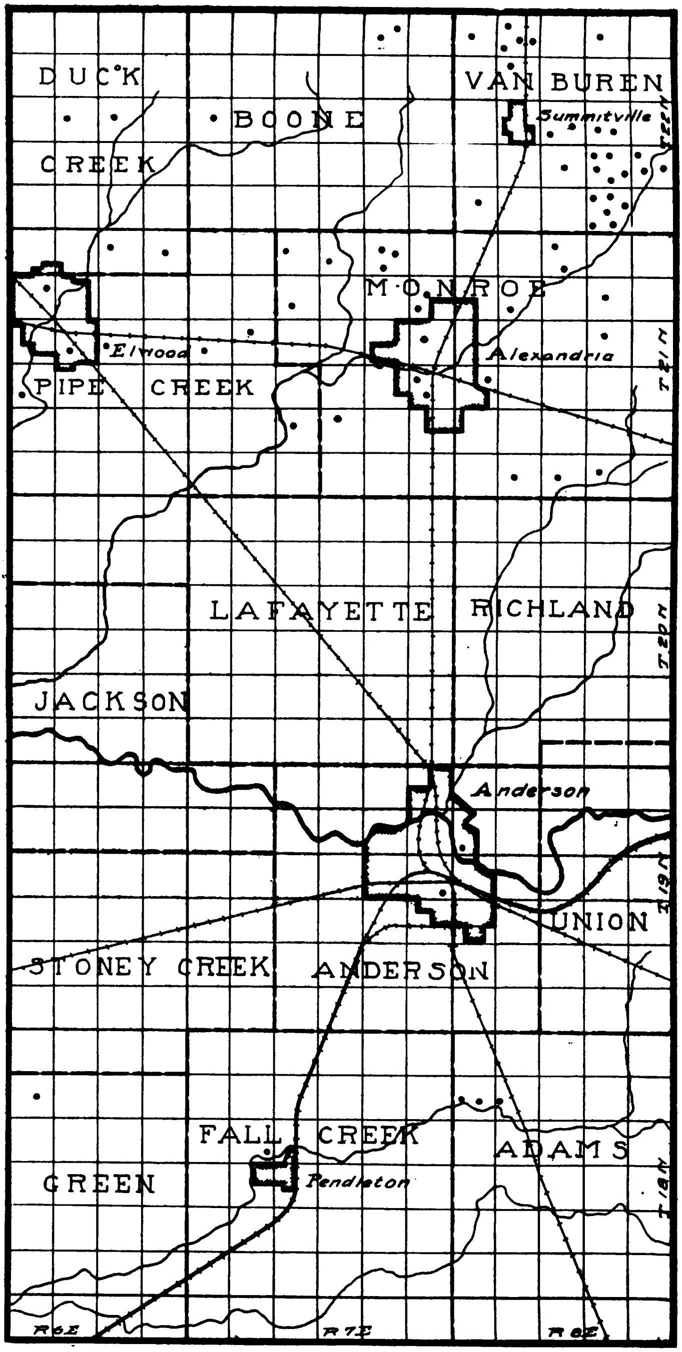

Fig. 45. Map of Madison County showing location of abandoned wells. Gas territory exists in the eastern tier and in Fall Creek Township, oil in Richland and Monroe.

MADISON COUNTY

The eroded surface of the Niagara limestone underlies the glacial drift in this county and may be reached at from five to one hundred and fifty feet. Gas has been produced in every township and oil in some parts of the county. The oil sand is reached at from 800 to 1200 feet. The surface of the Trenton lies between 100 feet above and 100 feet below sea level.

Anderson Township. The record of a well drilled at Anderson is given below:

Drift	114	feet.
Niagara limestone and shale	186	"
Clinton (?)	20	"
Hudson River and Utica	494	"
Trenton limestone	24	"
Total depth	838	feet.
Trenton above sea level	66	"

A great many wells were drilled in this township, most of which produced gas.

Boone Township. Wells were drilled and abandoned in section 11, 2 wells; section 19, 1 well.

Monroe Township. A well drilled at Alexandria has the following log:

Drift	20	feet.
Niagara limestone	261	"
Hudson River and Utica	611	"
Trenton limestone	5	"
Total depth	897	feet.

Well No. 3, B. Markle, Monroe Township.

Clay, gravel and quicksand	84	feet.
Limestone	246	"
Slate	593	"
Trenton rock at	923	"
In Trenton	77	"
Total depth	1000	feet.

Many wells were drilled and much gas and oil were obtained from this township. Wells have been abandoned in section 2, 3 wells; section 4, 2 wells; section 8, 1 well; section 10, 1 well; section 12, 2 wells; section 13, 1 well; section 15, 1 well; section 19, 1 well; section 24, 2 wells; section 27, 1 well; section 32, 1 well; section 33, 1 well; section 34, 1 well.

Van Buren Township. At Summit, the strata encountered are:

Drift	98	feet.
White limestone	45	"
Blue limestone	195	"
Soft bluish green shale	388	"
Black shale	200	"
Trenton limestone	45	"
Total depth	971	feet.

An oil well in the eastern limits of Summit yielded 120 barrels per day and has the following log:

Drive pipe	120	feet.
Casing	440	"
Top of Trenton	940	"
Total depth	1042	"

Wells have been abandoned in the following sections: Section 7, 1 well; section 8, 1 well; section 10, 1 well; section 17, 1 well; section 21, 2 wells; section 22, 2 wells; section 26, 3 wells; section 27, 5 wells; section 28, 1 well; section 31, 1 well; section 34, 6 wells.

Duck Creek Township. A well drilled on the William Shafer farm in section 24 has the following record:

Drive pipe	36	feet.
Casing	228	"
Top of Trenton	938	"
Total depth	1238	"

One well has been plugged in section 14, and one in section 15.

Pipe Creek Township. The following strata were encountered in a well at Elwood:

Drift	54	feet.
Niagara limestone and shale	270	"
Hudson river limestone	260	"
Utica shale	340	"
Trenton limestone	16	"
Total depth	940	feet.
Trenton below sea level	66	"

At Frankton the strata pierced by a well are as follows:

Drift	88	feet.
Niagara limestone and shale	272	"
Hudson River and Utica	480	"
Trenton limestone	22	"
Total depth	862	feet.

Two wells have been plugged, one in section 15, the other in section 28.

Fall Creek Township. At Pennelton, the first well drilled passed through the following:

Drift	5	feet.
Corniferous limestone	2	"
Sandstone	14	"
Upper Niagara shale	20	"
Limestone	200	"
Shale (Lower Niagara)	5	"
Limestone	4	"
Shale (green and brown)	610	"
Trenton limestone	87	"
Total depth	947	feet.
Altitude of well	841	"

Wells were plugged in 1913 in section 7 and one in section 16, in 1916.

Adams Township. Gas wells were drilled in and near Markleville. A few wells are still supplying gas (1919).

Wells were plugged in Green Township in sections 6 and 21 in 1911, and 1913, and in Lafayette Township in section 18 in 1916.

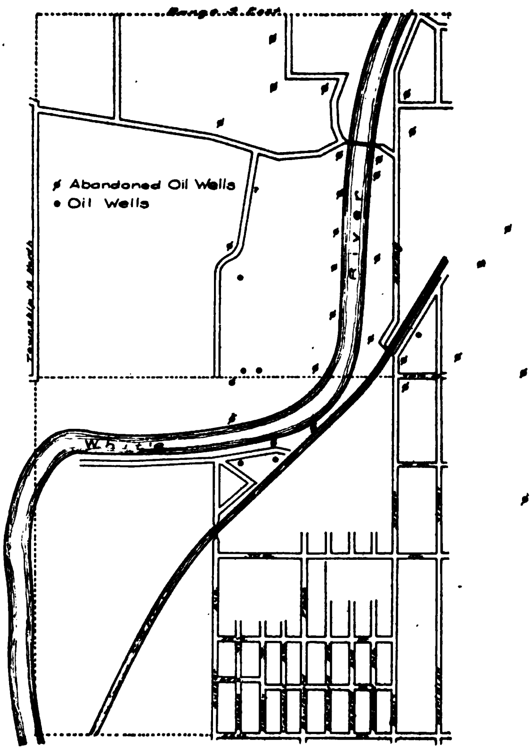

Fig. 46. Map showing location of Broad Ripple oil field in Marion County. Position of abandoned and pumping wells shown.

MARION COUNTY

The bed rock of this county consists of limestones of the Silurian age and limestones and shales of the Devonian and the Mississippian ages. These formations are concealed by glacial drift which varies in thickness from 25 feet to 200 feet. The surface of the Trenton lies from 100 feet above to 200 below sea level and the depth to the Trenton is from 800 to 1100 feet.

Washington Township. At Broad Ripple a number of oil wells have been brought in recently. The record of one of the wells is given below:

Drift	55	feet.
Corniferous limestone	48	"
Niagara limestone	257	"
Hudson River and Utica	504	"
Trenton limestone	24	"
Total depth	888	feet.
Trenton below sea level	109	"

Centre Township. A well at Brightwood passed through 199 feet of drift and reached the Trenton at 951 feet, below this a little gas and oil were obtained and salt water reached at 1181 feet. Eight producing gas wells were obtained northeast of Brightwood.

Lawrence Township. At Lawrence a number of wells were drilled. One was reported to have reached the Trenton at 1010 feet and salt water at 1015 feet.

Warren Township. A well drilled at Irvington reached the Trenton at 966 feet and salt water at 990 feet. At Cumberland the Trenton was reached at 1039 feet.

Wayne Township. The log of a well reported by Judge E. B. Martindale at Bridgeport is as follows:

Drift	160	feet.
Black shale	140	"
Limestone	360	"
Shale	490	"
Trenton limestone	50	"
Total depth	1200	feet.
Altitude of well about	750	"

The record of a well drilled one and one-half miles northwest of Bridgeport is as follows:

Drift (clay and gravel)	170	feet.
Soapstone (Knobstone shale)	85	"
Black and brown Genesee shale	125	"
Corniferous limestone	140	"
Niagara shale	50	"
Niagara limestone	100	"
Total depth	**670**	**feet.**

The following are the records of wells drilled on the farm of D. H. Wiggins, Broad Ripple, in 1918-1919:

	No. 1.	No. 2.	No. 4.	No. 7.	No. 8.	
Drive pipe	36	35	24	31	40	feet.
Casing	368	365	360	365	340	"
Sand at	858	854	855	848¼	860	"
Total depth	878	862¼	868	860	875	"

Two wells drilled on the farm of Mr. Britton of Broad Ripple in 1919 are as follows:

	No. 3.	No. 5.	
Drive Pipe	26	39	feet.
Casing	365	380	"
Sand at	864	867	"
Total depth	883	883	"

The following are the logs of two wells drilled on the Wheeler farm, in Broad Ripple, in 1919:

	No. 1.	No. 2.	
Drive pipe	51	72½	feet.
Casing	340	315	"
Sand at	853	847.4	"
Total depth	871	859	"

The following well was drilled on the Carter farm in 1919, in the Broad Ripple field:

Drive pipe	35	feet.
Casing	360	"
Sand at	851	"
Total depth	866½	"

MARSHALL COUNTY

Shales and limestones of Devonian age underlie the glacial drift in this county. The dip of the strata is toward the north, so for points of equal elevation above sea level, the Trenton is nearer the surface in the southern part of the county than in the northern part. The glacial drift which lies on the eroded surface of the bed rock has a thickness of from one hundred to two hundred and fifty feet. Plymouth has a number of flowing artesian wells which are forty to fifty feet deep and draw their supply from the glacial drift. The total thickness of the glacial drift at this point is 242 feet. In a deep well drilled at Plymouth, the Trenton was reached at 1368 feet. The altitude of the well is 783 feet, and the surface of the Trenton is 585 feet below sea level.

Minor folds may exist in the Trenton underlying the county, but the structural conditions of the strata cannot be determined by direct observation because the outcrops of the durolith are concealed by the glacial drift. Well records and other subsurface data are not of sufficient abundance to warrant the mapping of structural conditions.

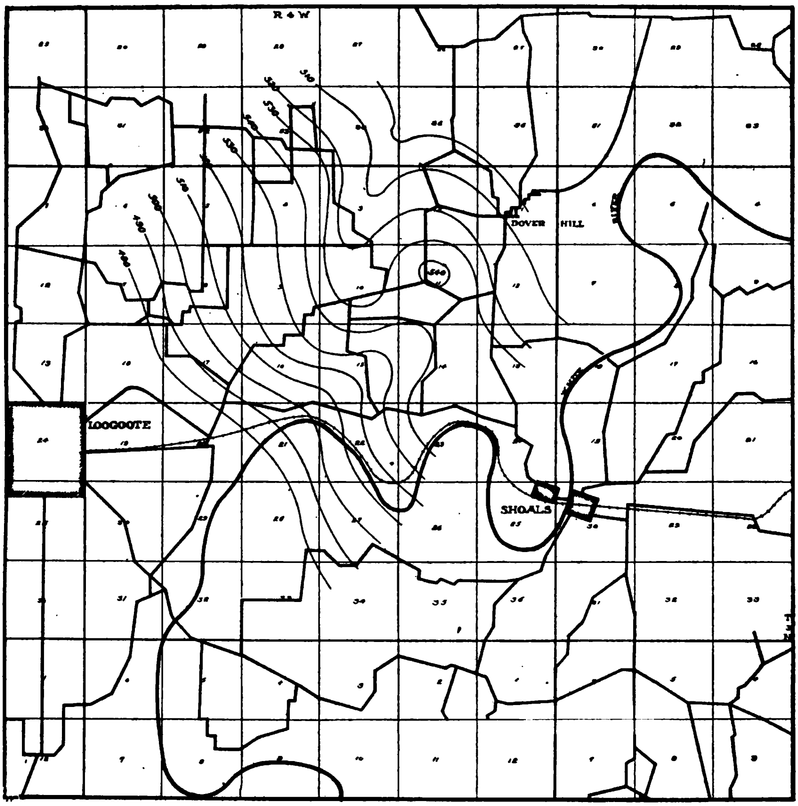

Fig. 47. A structural map of a portion of Martin County showing presence of a terrace. Contours drawn on limestone of Chester series.

MARTIN COUNTY

Martin County lies within the area of outcrop of strata of Pennsylvanian and the Mississippian age. Except for some filled-in valleys, the bed rock has been little affected by glacial deposition. The accessibility of the strata renders stratagraphical and structural work possible though the pronounced unconformity between the rocks of the ages mentioned above somewhat adds to the difficulties of correct interpretation. A general section of the rocks exposed in this county would include formations from the top of the Mitchell to and including a small part of the Allegheny. A generalized section is as follows:

Shales and sandstones containing coal (Coal Measures)	100 feet.
Conglomateratic sandstones, iron ore, shales and coal (Mansfield)	200 "
Shales, sandstones and limestones, Chester (Mississippian)	200 "

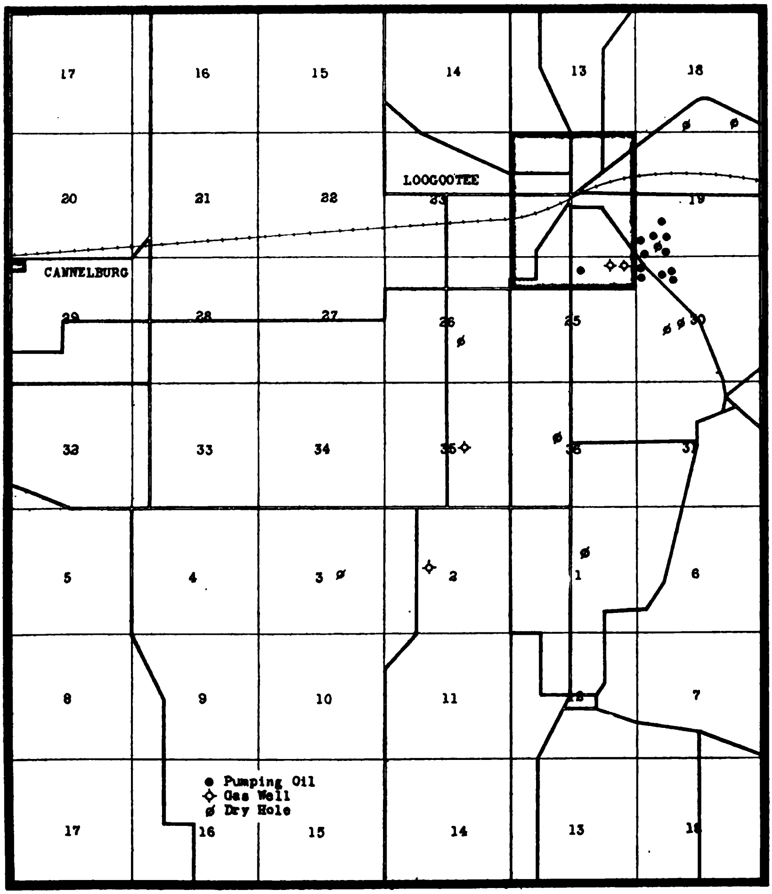

Fig. 48. Map of Loogootee oil and gas field showing location of oil, gas and dry wells, Martin County. Data collected by field party of 1919.

One of the best datum planes for use in drawing structural contours is the contact between the Beech Creek limestone and the Cypress sandstone which lies above. The extreme regularity in thickness of the Beech Creek, the presence of bold springs below, the massive character of the sandstone in connection with its position immediately overlying the limestone render the contact easy of recognition and materially lessens the possibility of its being confused with other limestone contacts of frequent occurrence in the Chester.

A structural map of a portion of Martin County has been constructed from data collected by the writer, Dr. C. A. Malott and other members of the field party of 1919. This map shows the presence of a terrace or possibly a low anticline in the area southwest of Dover Hill. Since the Loogootee field is so near, this may prove productive territory.

A deep well was drilled to a depth of 2200 feet southwest of Shoals and it is said that a small amount of gas was obtained.

A well drilled west of Shoals in section 26 reached oil at 1400 feet in the Corniferous. A well drilled in White River valley in the eastern part of Shoals reached salt water at 960 feet. This well was probably finished in the Knobstone.

Perry Township. A small oil field is located in the southwest part of section 19, the northwest part of section 30, and the southeast part of section 24. Dry holes were drilled in sections 19, 36, and 1. See map.

Rutherford Township. Two dry holes were drilled in section 1 on the property of Jno. D. Allen and D. E. Elliott.

MIAMI COUNTY

The eroded surface of the Silurian and the Devonian strata underlie the glacial drift in the county. The drift varies in thickness from a few feet to as much as 325 feet. Outcrops of the bed rock occur along the bed of Big Pipe Creek between Bunker Hill and the western boundary of the county. The rocks of Devonian age consist of limestones. Outcrops of Silurian rocks occur along the bed of Little Pipe Creek, the Wabash and the Mississinewa Rivers. Gas has been found in this county at Peru, Bunker Hill, Amboy and Xenia. The surface of the Trenton dips northward from Bunker Hill to Peru at the rate of 9 feet per mile.

The records of wells drilled at these points as given by Gorby and others are as follows:

Xenia Well[3].

Soil	4	feet.
Gravel	46	"
Water lime	31	"
Niagara	238	"
Hudson River and Utica	587	"
Trenton limestone	31	"
Total depth	937	feet.
Altitude of well	815	"
Trenton below sea level	91	"

Record of well drilled at Bunker Hill:

Section of Well No. 1.

Drift	58	feet.
Corniferous and Niagara limestone	503	"
Hudson River and Utica	431	"
Trenton limestone	12	"
Total depth	1004	feet.
Trenton below sea level	155	"

Record of well drilled at Peru:

Section of Well No. 4

Drift	36	feet.
Niagara (and Clinton) limestone	325	"
Hudson River and Utica	454	"
Trenton limestone	30	"
Total depth	905	feet.
Trenton below sea level	218	"

A small quantity of oil was found at a depth of 808 feet. Salt water occurred at 900 feet. This well was drilled in the northern part of the city.

Section of Well No. 2.

Drift	10	feet.
Water-lime and Niagara limestone	455	"
Clinton (?) limestone	15	"
Hudson River and Utica	449	"
Trenton limestone	27	"
Total depth	956	feet.
Trenton below sea level	229	"

Yielded a small quantity of oil and gas, but not sufficient for use. This well was bored a little south of the city limits, about 1¼ miles from well No. 1.

Section of Well No. 3.

Drift	70	feet.
Niagara limestone	490	"
Hudson River and Utica	400	"
Trenton limestone	42	"
Total depth	1002	feet.

A light flow of gas was obtained from this well. The above well was situated on the Younce farm, seven miles southeast of Peru.

Section of Well No. 4.

Drift	324	feet.
Niagara limestone	276	"
Hudson River and Utica	407	"
Trenton limestone	35	"
Total depth	1042	feet.

Yielded no gas.

Record of wells drilled in sections 16 and 28, S. E. ¼ of the N. E. ¼ of section 28:

Alluvium—river drift	36	feet.
Niagara limestone	385	"
Hudson River and Utica	454	"
Top of Trenton	875	feet.
Total depth	905	"
Surface above sea level	657	"
Top of Trenton below sea level	218	"

S. W. ¼ of section 16 (27 N. 4E):

Drift	324	feet.
Niagara limestone	379	"
Hudson River and Utica shale	307	"
Top of Trenton	1010	feet.
Total depth	1041	"
Surface above sea level	757	"
Top of Trenton below sea level	253	"

Hospital Hill.

Drift	20	feet.
Niagara limestone	375	"
Hudson River shales and limestone	255	"
Utica shale	248	"
Top of Trenton at	898	"
Total depth	933	"

This well was drilled in October, 1897, and produced 400 barrels of oil a day for four days. The production gradually dropped to 300 barrels when three weeks old.

Jackson Township. Record of well drilled at Amboy:

Section of Well No. 1.

Drift	'35	feet.
Niagara limestone and shale	350	"
Hudson River and Utica	522	"
Trenton limestone	33	"
Total depth	940	feet.

Yielded a strong flow of gas.

The following is a record of wells abandoned in this township:

Owner	Date	Sec.	Town	Range	Wells
C. C. Hull	1911	14	25	5E	1
E. L. Daniels	1913	20	25	6E	1
Chas. Friemal	1913	20	25	6E	1
E. L. Daniels	1913	24	25	5E	1
E. Hooper	1913	29	25	6E	1
E. L. Carter	1913	30	25	6E	1
E. Gross	1913	32	25	6E	1

MONROE COUNTY

Geology. The eastern portion of the county lies within the area occupied by the Knobstone, the central portion is occupied by the Harrodsburg, Salem and Mitchell limestones, the western portion by the Chester shales, limestones and sandstones while the highlands in the extreme western portion are occupied by the Pottsville.

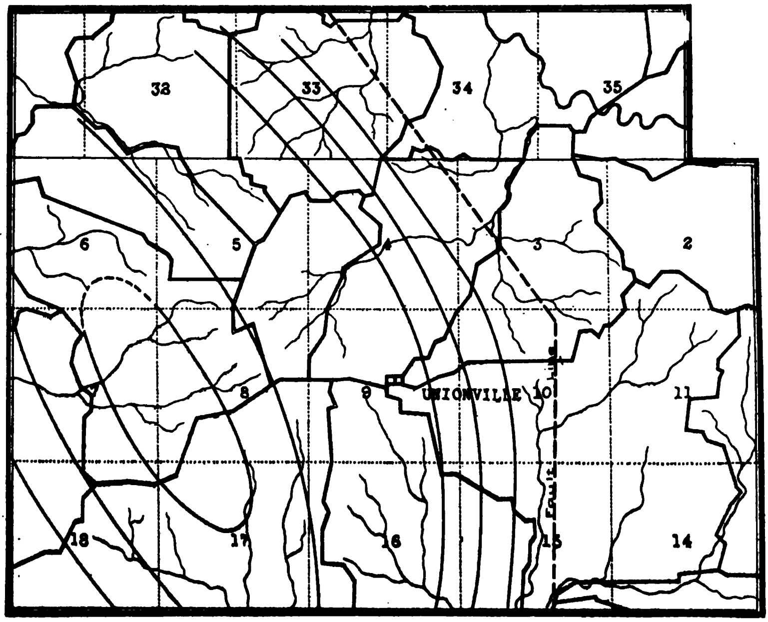

Fig. 49. A structural map of a portion of Monroe County.

Structure. The Mount Carmel fault crosses the eastern part of the county and near Unionville makes a change in direction which makes conditions favorable to anticlinal folds. The fault itself with its downthrow toward the east produces an anticlinal fold extending parallel to the fault but not a closed structure except at such places as cross flextures are produced.

Bloomington Well. A deep well was drilled in the courthouse yard in 1885 to a depth of 2730 feet. A generalized record of the well follows:

Surface loam	6	feet.
Mississippian limestones and shales	749	"
Devonian shales and limestones	170	"
Niagara limestone	240	"
Hudson River limestone	485	"
Utica shale	180	"
Trenton limestone	626	"
Potsdam sandstone	274	"
Total depth	2730	feet.
Altitude of well	770	"

No oil or gas was found in this well, which was drilled for an artesian water supply. The complete record is given below:

Earth	6	feet
St. Louis limestone, water	30	"
Keokuk limestone	89	"
Knobstone	630	"
Red shale	20	"
Blue limestone	5	"
Brown shale, gas	10	"
Black slate, Devonian	120	"
Gray limestone, Portland cement	15	"
Brown limestone, Niagara	240	"
Shaly limestone	15	"
Light brown limestone	130	"
Flinty limestone	30	"
Light colored limestone	100	"
Brown limestone	70	"
Blue shale	40	"
Blue limestone	40	"
Blue shale, streaks of limestone	60	"
Blue shale	180	"
Grey limestone, some shale	586	"
Blue shale	40	"
Hard, white sandstone	4	"
Shaly limestone and sandstone	20	"
Gray limestone and sandstone	20	"
Shaly limestone, sandstone quartzite	98	"
White and yellow, hard sandstone, iron	22	"
White sandstone, softer	20	"
White sandstone, soft	40	"
Gray limestone and sandstone, mixed	42	"
Gray limestone, sulphur-water increasing rapidly	8	"
Total	2730	feet.
Trenton below sea level about	1060	"

Well east of Coleman House, west of Thrasher Schoolhouse:

Oolitic limestone at	130	feet.
Soil	6	"
Sandstone and iron ore	7	"
White sandstone	5	"
Iron stone	5	feet, 6 inches.
Brown sandstone	34	"
Coal	6	"
Blue sandstone	22	feet, 6 inches.
Blue sand	17	"
Iron stone	27	"
Limestone	3	"
Total depth	133	feet.

Well southeast of Thrasher Schoolhouse:

	Thickness		Total Depth	
Drift	10	feet.	10	feet.
Iron stone	5½	“	15½	“
Shale	6	“	21½	“
Iron stone	4½	“	26	“
Blue sandstone	15	“	41	“
Kaolin	5½	“	46½	“
Blue sandstone	22	“	68½	“
Coal	4½	“	73	“
Blue shale	26	“	99	“
Blue sandstone	19	“	118	“
Iron stone	22	“	140	“
White limestone, water	140	“	280	“
Shale	60	“	340	“
Brown limestone	45	“	385	“
Shale	5	“	390	“
Brown limestone	20	“	410	“
Blue limestone, water	130	“	540	“
Quartz	20	“	560	“
White sandy shale	100	“	660	“
Blue shale	360	“	1020	“
Sand	25	“	1045	“
Blue shale	127	“	1172	“
Bed rock	7	“	1179	“
Shale	18	“	1197	“
Limestone	7	“	1204	“
White sandstone	6	“	1210	“
Dark shale	35	“	1245	“
Iron pyrite	10	“	1255	“
Brown shale and iron	33	“	1288	“
Black shale, hard	30	“	1318	“
White limestone	24	“	1342	“
Limestone	9	“	1351	“
White gray limestone	85	“	1436	“
Brown limestone	25	“	1461	“
Gray limestone	10	“	1471	“
Brown limestone	25	“	1496	“
White limestone	16½	“	1511	“
Brown and gray limestone	28	“	1539	“
Gray limestone	17	“	1556	“
Black shale	22	“	1578	“
Limestone (Niagara)	6	“	1584	“
Pure white limestone	92	“	1676	“
Black limestone	24	“	1700	“
Gray limestone	25	“	1725	“
Gray limestone and water	11	“	1736	“
Coarse limestone and gas	9	“	1745	“
Gray limestone	35	“	1780	“

Brown limestone	23	feet	1803	feet
Gray limestone	10	"	1813	"
Blue limestone	37	"	1850	"
Blue shale	15	"	1865	"
Blue shale	15	"	1880	"
Blue limestone	9	"	1889	"
Blue shale	11	"	1900	"
Shale (Utica)	50	"	1950	"
Shale (Utica)	15	"	1965	"
Black shale	35	"	2000	"
Blue and black shale	274	"	2274	"
Trenton limestone	301	"		"
Total depth			2575	feet.

Top of Trenton at 2272 feet.

Oil sand at 2301 feet. Light initial production.

Altitude at mouth of the well 975 feet.

There is a dip of thirty-five feet to the mile for the Trenton limestone between the deep well at Bloomington and the Koontz well. In the former the Trenton is 1060 feet below sea level and in the latter 1300 feet.

MONTGOMERY COUNTY

A small area of the bed rock in the western portion of this county is occupied by Pennsylvanian strata, but the greater part of the subsurface of the county is occupied by the strata of the Mississippian age. The covering of the glacial drift in a large measure prevents the determination of structural conditions of the strata. The surface of the Trenton lies from 1200 to 1600 feet below the surface of the county. The dip of the strata is toward the southwest, dipping away from the Cincinnati arch, which lies to the north. The surface of the Trenton lies from 400 to 800 feet below sea level.

The following is the record of well No. 1 drilled at Crawfordsville[2]:

Drift	140	feet.
Sub-Carboniferous rocks	410	"
Devonian shale	80	"
Corniferous limestones	55	"
Niagara limestone	380	"
Hudson River and Utica	365	"
Trenton limestone	69	"
Total depth	1499	feet.
Trenton below sea level	664	"

Yielded no gas.

Railroad Elevations.

Linden, 787; Cherry Grove, 797.5; Manchester, 753.4; Crawfordsville, 738.5; Whitesville, 871; Ladoga, 822.5; New Ross, 877; Pawnee, 846; Lapland, 840; Penobscot, 859; Waveland, 744; Sand Creek, 582.

MORGAN COUNTY

The glacial mantle covering the bed rock in this county varies from a few feet to ninety feet. The Knobstone division of the Mississippian underlies the drift over a large part of the county. Outcrops of the Knobstone occur, but they are not sufficiently abundant to be of much service in locating favorable structural conditions. Even if a sufficient number of outcrops could be found the absence of sufficient number of persistent hard layers of rock would render the determination of structural conditions exceedingly difficult. In the presence of favorable conditions, oil and gas sands may be found in the Devonian and the Trenton strata. The Trenton will be found below the surface at a depth ranging from 1400 to 1600 feet.

Two wells were drilled south of Hall, in 1916. The first one was drilled to a depth of about 860 feet and had a showing of oil in the Corniferous limestone. The well was shot, but the shot did not increase the show of oil.

Section of Well No. 1, Martinsville, Ind.

Drift	85	feet.
Sub-Carboniferous rocks	323	"
Hamilton shale	120	"
Corniferous limestone	62	"
Niagara limestone	236	"
Hudson River and Utica	571	"
Trenton limestone	51	"
Total depth	1448	feet.
Trenton below sea level	780	"

Yielded no gas.

Jackson Township. A well was drilled on the Donald Stewart property in Section 1 in 1911 and another on the Emory Hilderman property in Section 36 in 1912. Both were non-productive.

NEWTON COUNTY

The subsurface of Newton County is occupied by the strata of the Silurian in the central portion and northern portion of the county and by the Devonian strata in the southern portion of the county. The strata of the northern portion dip north and those of the southern portion toward the south. Slight variations in the uplift of the arch formed has resulted in the creation of at least one minor fold favorable to the accumulation of oil. This occurs in the boundary between Newton and Lake Counties near the town of Thayer.

The following formations will be encountered in this county between the surface of the glacial drift and the surface of the Trenton:

	Thickness.	
Glacial drift	100 to 150	feet.
Devonian (in Southport)	50 " 145	"
Silurian	280 " 300	"
Hudson River	300	"
Utica	210	"

On the north boundary at Thayer the Trenton is encountered at 846 feet where the surface elevation is 650 feet. At Kentland in the part of the county at an elevation of 680 feet the Trenton is encountered at 1060 feet. The dip of the Trenton surface is more than 57 feet to the mile toward the south.

On account of the covering of glacial drift which attains a thickness of more than one hundred feet, the geological structures favorable to the accumulation of oil cannot be determined or located by the use of surficial methods. The oil which has been found is probably in the Trenton limestone. The following is a log of well No. 2 drilled on the Grant farm west of Thayer by the Thayer Oil and Gas Co., Lincoln Township:

Oil sand	at	615	feet.
Thickness of gas sand	"	20	"
Salt water at	"	675	"
Trenton rock at	"	846	"
Oil at	"	850	"
Total depth	"	862	feet.

This well was plugged in 1919, as was a well on the Pebecca Spitter property.

Well No. 3.

Drift	73	feet.
Niagara limestone	283	"
Hudson River limestone	300	"
Utica shale	190	"
Trenton limestone	6	"
Total depth	852	feet.

Record of well drilled at Kentland:

Section of Well No. 1.

Drift	100	feet.
Black shale (New Albany)	100	"
Corniferous	45	"
Niagara limestone	305	"
Hudson River limestone	300	"
Utica shale	210	"
Trenton limestone	60	"
Total depth	1120	feet.
Trenton below sea level	379	"

Yielded no gas.

NOBLE COUNTY

Noble County probably lies wholly within the area occupied by the Devonian strata, though its bed rock is concealed by a heavy mantle of glacial drift. A well record at Albion shows a thickness of 375 feet and at Kendallville of 485 feet of drift. The well at Kendallville reached the Trenton at 1920 feet.

A well drilled at Albion furnished the following log[1]:

Section of Well No. 1.

Drift	375	feet.
Devonian shale	65	"
Devonian limestone	65	"
Sandstone	5	"
Hydraulic limestone	30	"
Niagara and Clinton (?) limestone and shale	815	"
Hudson River limestone and shale	285	"
Utica shale	250	"
Trenton limestone	24	"
Total depth	1914	feet.
Trenton below sea level	1161	"

Yielded small flow of gas.

The surface of the Trenton dips northward through this county at the rate of from thirty-five to thirty-eight feet to the mile. If there are structures developed in these northward dipping strata they are not visible at the surface because of the thick over-burden of drift, which prevents the detection of reverse dips.

Railroad Elevations.

LaOtto, 872.9; Swan, 872; Avilla, 962.9; Kendallville, 974.7; Rome City, 920.3; Grismore, 868.2; Ligonier, 893.8; Wawaka, 952.1.

OHIO COUNTY

The Cincinnatian Division of the Ordovician including the Eden, (Utica) Maysville, (Lorraine) and Richmond from the strata underlying the Pleistocene and Recent deposits of this county. The Pleistocene deposits vary in thickness from a few to fifty feet. The Ordovician sediments that are revealed consist of a series of shales and limestones. The Trenton limestone lies below these formations. The number and abundance of out-crops will probably make it possible to determine the structural conditions existing in this county, but careful detailed work will be required. The table below gives the sub-divisions which are represented in the county.

Quaternary	Recent, clays and alluvium		
	Pleistocene, gravels, sands and till		
Ordovician	Cincinnati	Richmond	Elkhorn
			Whitewater
			Saluda
			Waynesville
			Arnheim
		Maysville	Mt. Auburn
			Corryville
			Bellevue
			Fairmont
			Mt. Hope
		Eden	McMicken
			Southgate
			Economy
			Fulton
		Trenton	

ORANGE COUNTY

This county lies within the unglaciated area and the structural conditions of the rocks may be determined for the greater part of the county by surficial observations. The eastern part of the county contains the Salem and the Mitchell limestones of the Mississippian. The western part of the county contains the shales, sandstones and the limestones of the Chester division of the Mississippian and the conglomeratic sandstones of the Pottsville division of the Pennsylvanian. Where the geologic conditions are favorable there is a probability of the accumulation of oil and gas in the Devonian strata (Corniferous limestone) which may be reached in the western part of the county at a depth of from 1100 to 1400 feet. There is also a probability of oil and gas accumulating under such structures in the Trenton though the Trenton limestone may lack porosity due to the lack of dolomitization.

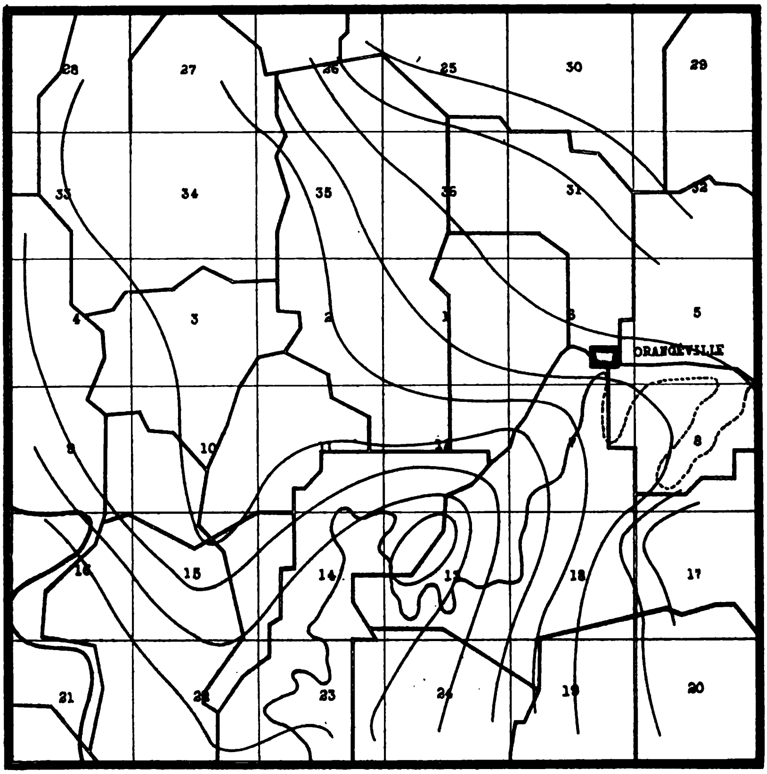

Fig. 51. Map of a portion of Orange County showing structural conditions near Orangeville. Contour lines drawn on Chester limestone. Data secured by C. A. Malott and P. B. Stockdale of field party of 1919.

A general geological section in this county would include:

Reddish conglomeratic sandstone with iron ore (Pottsville)	200 feet.
Fine grained massive sandstone (Tar Springs, Chester)	45 "
Limestone, gray (glendeane)	10 "
Sandstone and sandy shales (Hardinsburg, Chester)	50 "
Limestone, thin bedded (Colconda)	16 "
Sandstone, massive (passing to shale, Cypress)	35 "
Limestone, massive (Beech Creek)	12 "
Shales and sandstones (Elwren)	32 "
Limestone, pyritiprous, reddish (Reelsville)	4 "
Sandstone and shales (Brandy Run)	13 "
Limestone, massive ledges (Beaver Bend), Top of Mitchell	10 "
Limestone (Mitchell, Salem, Harrodsburg)	400 "

Two wells were drilled at Paoli, one to a depth of 1,000 feet, the other to a depth of 1,130 feet. In the first mineral water was found at 250 feet and in a blue shale at 1,000 feet. The bottom of this well is probably in

the Silurian shale. Its altitude is about 580 feet. The second well encountered mineral water in a limestone at 1,130 feet and probably was completed in the Silurian limestone. These wells were drilled for oil or gas and were drilled without reference to structure. By consulting the structure map accompanying this report it will be evident that no favorable structure is present. A well drilled in Section 8 southwest of Paoli reached a depth of over 1200 feet before being abandoned. This well was drilled on a slight shoulder or terrace as will be seen by consulting the structure map. The field work necessary to the preparation of this map was done by Dr. C. A. Malott and Mr. P. B. Stockdale.

OWEN COUNTY

The geological formations represented by the outcrops in this county are found in the following section:

Quaternary	Recent—River alluvium.
	Pleistocene—Glacial gravels, sands and clays.
Pennsylvanian	Coal measures—coal beds, sandstones, shales and limestones.
	Mansfield (Pottsville) sandstone shales and coal.
Mississippian	Chester, shales, limestones, and sandstones.
	Mitchell, limestones and shales.
	Salem, limestone.
	Warsaw, limestone.
	Knobstone, shales and sandstones.

The Pleistocene deposits mantle the surface in all places except along the courses of streams, where it has been removed by postglacial erosion. The number of outcrops may be sufficient in some places in the county to enable the structures of the bed rock to be determined.

Washington Township. Three wells were drilled in Spencer to the Niagara limestone from which a supply of sulphur-saline water was obtained. A well was also drilled south of Spencer and a showing of oil obtained at a depth of 800 feet. This well was drilled deeper, but did not strike production.

A well was drilled on the Tanner property in Section 20 west of Spencer in 1913. No record of this well has been obtained.

PARKE COUNTY

The strata of the Pennsylvanian period underlie the glacial drift in Parke County. Outcrops of the bed rock occur along the beds of some of the streams, but the structural condition cannot be determined from surficial oobservations.

The Trenton limestone lies from 2000 to 2500 feet below the surface in this county. The following is the record of a well drilled at Rockville.

Section of Well No. 1.

Drift	96	feet.
Gray sandstones	44	"
Brown shale	25	"
White sandstones	110	"
Black shale	25	"
Black shale	105	"
White sandstone	50	"
Limestone	170	"
Gray shale	305	"
Sandstone	100	"
White shale	114	"
Black shale	102	"
Limestone	118	"
Brown sandstones	46	"
White limestones	135	"
Crystallized limestone	85	"
White shale, like kaolin	48	"
Limestone	108	"
Dark shale (Utica)	324	"
Total depth to Trenton	2100	feet.
Altitude of well	688	"
Trenton below sea level	1412	"

Yielded no gas.

In 1908 a bore was sunk to a depth of 1200 feet near Diamond, in Parke County but was dry.

Where structural conditions are favorable oil may be found in the Devonian in this county.

PERRY COUNTY

As Perry County occupies a part of the unglaciated area of Indiana the outcrop of its strata is unconcealed. The formations of the county belong to the following divisions:

Quaternary	Recent—alluvium and residuals Pleistocene—residuals
Pennsylvanian	Allegheny—shales, sandstones, limestones, coals Pottsville—shales, sandstones and coal
Mississippian	Chester—limestones, sandstones and shales

No structural map of this county has been attempted, but it seems possible to determine the structural conditions for a large part of the county

by using the limestones of the Chester as key formations.

Some oil was found in two wells in section 19 near Uniontown, also in sections 24 and 26. The records of these wells are given below:

Wells drilled in Clark Township east of Siberia, near Anderson River six miles south of Birdseye.

Well in Southwest ¼ of Section 24.

Drive pipe	40	feet.
Casing	595	"
Top of pay	1010	"
Total depth	1030	"

Well in Southeast ¼ of Section 26 (3S. 3W.)

Drive pipe	10	feet.
Casing	725	"
Total depth	1280	"

The above well came in as a salt water without a showing of oil.

Northeast ¼ of the Southwest ¼ of Section 19.

Drive pipe	60	feet.
Casing	600	"
Total depth	1040	"

Better producer than No. 1.

Record of Deep Well at Cannelton.

	Thickness Feet	Depth Feet
Sand	47	47
Shale	110	157
White sand	63	220
Shale	9	229
Limestone	41	270
Shale	5	275
Hard limestone, white	55	330
Shale	16	346
Limestone	6	352
White sand	5	357
Shale	3	360
Sand	13	373
Shale	23	396
Black limestone	10	406
Grey shale	30	436
White limestone	9	445
Grey shale	15	460
White shale salt water at 480	51	511
Shale	7	518
White limestone salt water at 733	218	736
Limestone salt water at 774	204	940
Dark sandy shale	87	1027
Dark brown limestone	81	1108
Limestone	572	1780
Shale (Utica)	120	1900
Limestone (Trenton)	633	2533

Tell City Well Record.

Soil	25	25
Grey shale	10	35
White sand	40	75
Brown sand	80	155
White limestone	30	185
Dark grey shale	30	215
Shally lime	10	225
Limestone	5	230
Greenville shale	45	275
Limestone	71	346
Grey sand	6	352
Grey limestone and shale	43	395
Sand	15	410
Varigated shales	116	526
Limestone	33	559
Grey shale	36	595
Grey sand	20	615
Liemstone and shale	3	618
Limestone	17	635
Brown shale	13	648
Grey sand	27	675
Brown shale	5	680
Sand stone	62	742
No record	10	752
Grey limestone	168	920
Light limestone	245	1165

PIKE COUNTY

The strata of Pike County belong to the coal measures with the exception of a mantle of glacial drift in the northern portion, of glacial lake deposits in the central portion and recent residuals covering the southern portion and overlying the coal measures. As many as eight distinct veins of coal occur in the county. Three or four of these are workable over considerable area. For the determination of structural conditions it is possible that some use may be made of the Coal Measures. Oil fields have been developed northeast of Petersburg, southwest and southeast, in Washington Township, Madison, Monroe, Patoka and Logan Townships. Some of the structures in this county were outlined on the Petersburg coal and published in the Ditney folio[1].

Madison Township. Oil sands range in depth from 960 to 1340. Five sands are reported.

[1]See Ditney Folio, U. S. G. S.

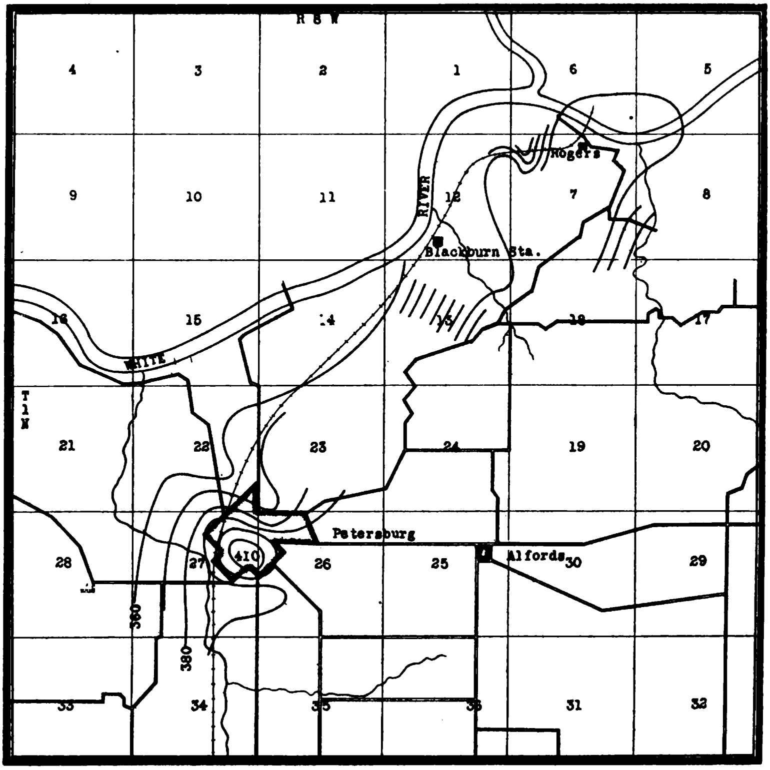

Fig. 52. Map of portion of Pike County showing outline of structure at Petersburg. Contour lines drawn on Coal V by C. A. Malott and P. B. Stockdale, field party 1919.

Well No. 3, D. & R. Snyder farm. Section 35, Madison Twp.:

Soil .... to	5 feet.
Mud	45 "
Quick sand	55 "
White sand	95 "
Slate	100 "
Coal	105 "
Slate	165 "
Sand	175 "
Slate	375 "
Shale	391 "
Lime	420 "
Coal	423 "
Sand	433 "
Blue sand	453 "
Dark lime	463 "
Slate	523 "

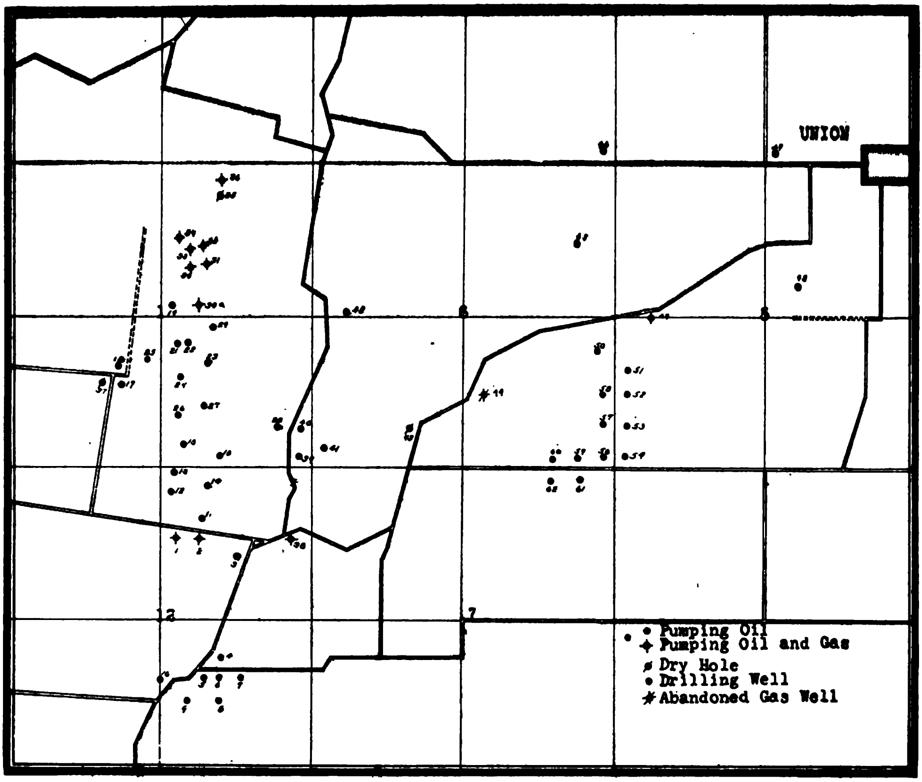

Fig. 53. Map of the Union oil field showing oil and gas wells and dry holes. Data collected by C. A. Malott and P. B. Stockdale of field party of 1919.

Lime	to	540	feet
Shale		690	"
Sand		710	"
Water sand		800	"
Slate		845	"
Lime		850	"
Slate		870	"
Sharp sand		935	"
Gray slate		945	"
Lime		960	"
Slate		1005	"
Sand		1015	"
Shale		1035	"
Water sand		1140	"
Slate		1145	"
Little lime		1163	"

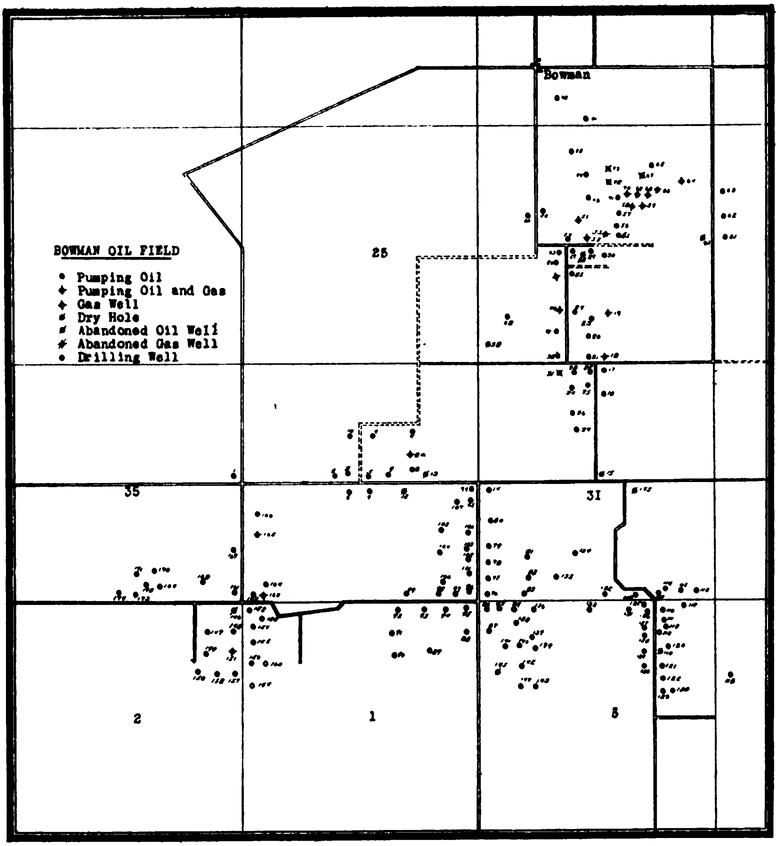

Fig. 54. Map of the Bowman oil field in Pike County, showing location of oil wells, dry holes and gas wells. Data secured by C. A. Malott and P. B. Stockdale, field party of 1919.

Slate	to	1193	feet
Dark lime		1200	"
Shale		1205	"
Lime		1215	"
Slate		1245	"
Dark sand		1253	"
Big lime		1275	"
Slate		1285	"
Sand		1295	"
Shale		1300	"
Gas sand		1303	"
Slate		1304	"
Snyder sand		1313	"
Slate		1323	"

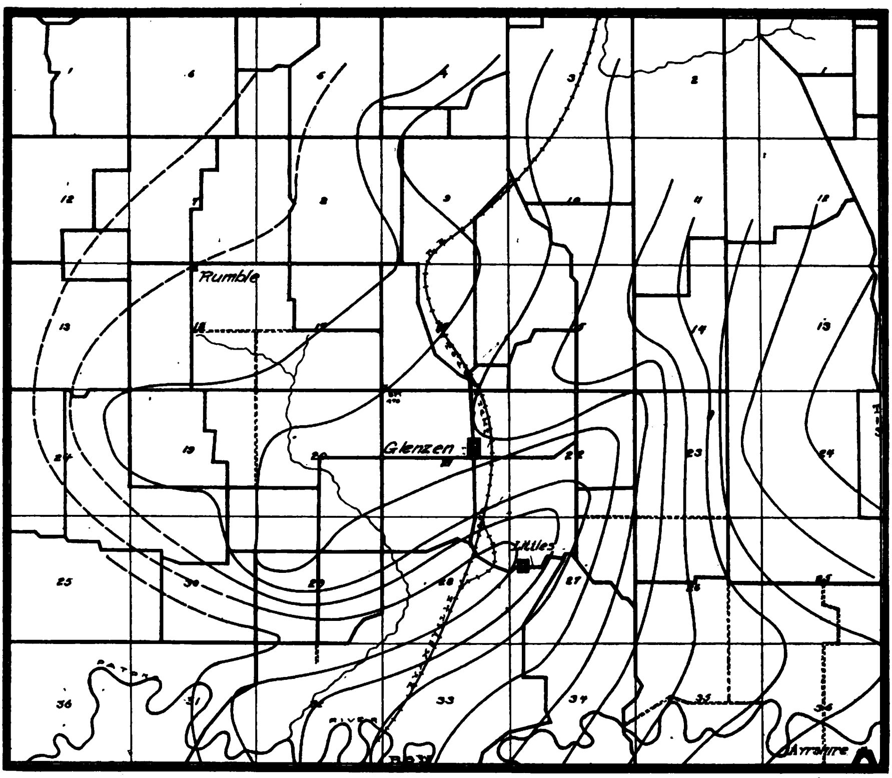

Fig. 55. Map of the Glenzen terrace in Pike County. Structure lines drawn on Coal V. Data secured by C. A. Malott and P. B. Stockdale, field party of 1919.

Brown shell	to	1330 feet
Slate		1341 "
Dark sand		1347 "
Brown sand		1348 "
Total depth		1348 feet.

Casing Record.

12½ in.	71 feet.
10 in.	392 "
9¼ in.	945 "
6½ in.	1210 "

Well No. 5, L. Johnson Farm. Madison Twp. Pike Co., Oct. 6, 1919:

Clay	61 feet.
Slate	79 "
Coal	1 "

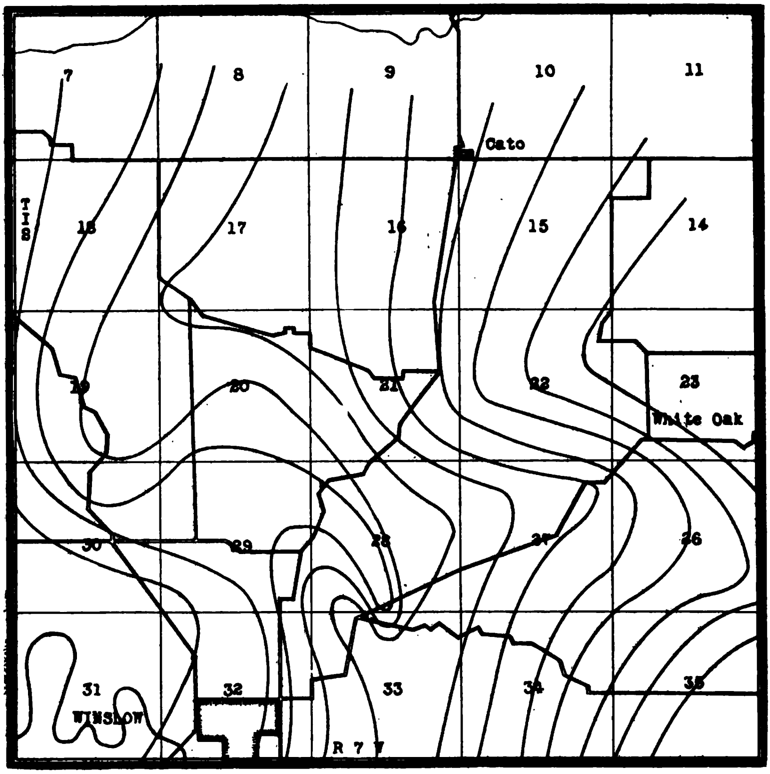

Fig. 56. Map of structural conditions near Winslow. Contours drawn on Coal V. Data secured by C. A. Malott and P. B. Stockdale of the field party of 1919.

Slate	319	feet
Lime	6	"
Slate	414	"
Sand	55	"
Slate	75	"
Oil sand	15	"
Lime	7	"
Slate	38	"
Water sand	110	"
Lime	8	"
Slate	7	"
Sand	35	"
Slate	35	"
Big lime	27	"
Slate	29	"
Oil sand	24	"
Total depth	1346	feet.

Well No. 5, M. E. Sutton farm, Madison Township, Pike County:

Surface	to	1	foot.
Quick sand	"	16	feet.
Shale	"	30	"
Coal	"	55	"
Shale	"	58	"
Lime	"	95	"
Shale	"	115	"
Lime	"	125	"
Shale	"	130	"
Lime	"	180	"
Shale	"	200	"
Sand	"	285	"
Shale	"	315	"
Lime	"	420	"
Shale	"	428	"
Sand	"	580	"
Shale	"	600	"
Lime	"	720	"
Shale	"	725	"
Sand	"	800	"
Shale	"	885	"
Lime	"	925	"
Sand oil	"	942	"
Total depth	"	963	feet.

Record of Dan Snyder No. 2, Section 36, Madison Township:

12¼" casing	92	feet.
10" casing	210	"
8¼" casing	915	"
6¼" casing	1240	"
4⅞" liner	80	"

Soil	35	feet.			
Quick sand	35	"	to	45	feet
Blue mud	45	"	"	95	"
Lime shell	95	"	"	130	"
Blue mud	130	"	"	155	"
Brown shale	155	"	"	200	"
Coal	200	"	"	205	"
Gray mud	205	"	"	230	"
White mud	230	"	"	265	"
Lime	265	"	"	295	"
Sand	295	"	"	340	"
Blue mud	340	"	"	370	"
White mud	370	"	"	435	"
Lime	435	"	"	440	"
Blue mud	440	"	"	490	"
Lime	490	"	"	500	"
Gray mud	500	"	"	535	"

Shale	535	feet	to	585	feet	
Brown mud	585	"	"	640	"	
Water sand	640	"	"	660	"	
Slate and shale	660	"	"	720	"	
Light shale	720	"	"	780	"	
Slate	780	"	"	850	"	
Shale	850	"	"	875	"	
Water sand	875	"	"	910	"	
Brown mud	910	"	"	930	"	
Slate	930	"	"	994	"	
Rumble sand	994	"	"	1011	"	No oil
Slate	1011	"	"	1016	"	
Brown mud	1016	"	"	1025	"	
Sand	1025	"	"	1060	"	
Sandy shale	1060	"	"	1095	"	
Water sand	1095	"	"	1125	"	
Slate	1125	"	"	1135	"	
Shale	1135	"	"	1158	"	
Gray mud	1158	"	"	1170	"	
Lime	1170	"	"	1190	"	
White mud	1190	"	"	1195	"	
Hard lime	1195	"	"	1210	"	
Blue mud	1210	"	"	1234	"	
Big lime	1234	"	"	1249	"	
Slate	1249	"	"	1264	"	
Red rock	1264	"	"	1273	"	
Shale	1273	"	"	1283	"	
Snyder sand	1283	"	"	1302	"	
Total depth				1302	"	

Central Refining Co.

Well No. 9. Section 35, Madison Twp.:

Clay	to	18	feet.
Sand	"	70	"
Brown shale	"	75	"
Coal	"	77	"
Brown shale	"	135	"
Lime	"	148	"
Gray slate	"	160	"
Lime	"	165	"
Gray slate	"	180	"
Brown slate	"	205	"
Coal	"	208	"
Lime	"	211	"
Brown slate	"	215	"
Lime	"	222	"
Gray slate	"	250	"
Brown slate	"	260	"
Lime	"	288	"

Brown slate	to	290	feet
Gray slate	"	310	"
Brown slate	"	350	"
Gray slate	"	390	"
Brown slate	"	430	"
Sand	"	438	"
Brown slate	"	440	"
Lime	"	443	"
Brown slate	"	450	"
Gray slate	"	490	"
Brown slate	"	488	"
Lime	"	500	"
Coal	"	503	"
Gray slate	"	515	"
Lime	"	522	"
Brown slate	"	560	"
Gray slate	"	600	"
Brown slate	"	650	"
Gray slate	"	690	"
Sand	"	696	"
Brown slate	"	715	"
Gray slate	"	755	"
Sand	"	760	"
Brown slate	"	800	"
Gray slate	"	830	"
Brown slate	"	858	"
Sand	"	872	"
Brown slate	"	880	"
Sand	"	940	"
Gray slate	"	946	"
Lime	"	950	"
Gray slate	"	955	"
Lime	"	965	"
Gray slate	"	1050	"
Sand	"	1060	"
Gray slate	"	1080	"
Sand	"	1160	"
Little lime	"	1172	"
Gray slate	"	1200	"
Lime	"	1210	"
Gray slate	"	1220	"
Lime	"	1225	"
Gray slate	"	1230	"
Big lime	"	1238	"
Gray slate	"	1250	"
Lime	"	1258	"
Gray slate	"	1261	"
Lime	"	1265	"
Brown slate	"	1275	"
Red rock	"	1277	"

Brown slate	to 1313	feet
Sand	" 1319	"
Brown shell	" 1325	"
Slate	" 1326	"
Lime	" 1328	"
Slate	" 1340	"
Gray sand	" 1345	"
Brown sand	" 1348	"
Total depth	1348	feet.

Casing Record.

12½ in.	70	feet.
10 in.	442	"
8¼ in.	948	"
6¼ in.	1231	"

Wells abandoned in this township are located in Section 1, 1 well; Section 2, 2 wells; Section 6, 2 wells; Section 25, 1 well; Section 35, 2 wells; Section 36, 2 wells.

Log of M. F. Snyder Well. Located in Section 2, Madison Twp.:

Yellow clay	to 10	feet.
Gray slate	30	"
Sand	47	"
Gray slate	85	"
Sand	93	"
Gray slate	95	"
Coal	97	"
Lime	103	"
Gray slate	135	"
Brown slate	150	"
Lime	165	"
Gray slate	170	"
Sand	180	"
Brown slate	185	"
Sand	210	"
Gray slate	240	"
Sand	265	"
Brown slate	268	"
Coal	272	"
Lime	277	"
Coal	280	"
Gray slate	295	"
Lime	310	"
Sand	362	"
Brown slate	372	"
Gray slate	380	"
Sand	384	"
Gray slate	405	"
Brown slate	407	"
Lime	442	"
Gray slate	460	"

Brown slate	to 463 feet
Coal	467 "
Gray slate	483 "
Lime	485 "
Brown slate	495 "
Lime	513 "
Gray slate	525 "
Brown slate	528 "
Coal	530 "
Brown slate	558 "
Lime	560 "
Brown slate	580 "
Gray slate	590 "
Brown slate	625 "
Sand	635 "
Sand	675 "
Brown slate	700 "
Gray slate	735 "
Brown slate	790 "
Sand	820 "
Brown slate	832 "
Sand	838 "
Gray slate	842 "
Sand	869 "
Coal	872 "
Gray slate	875 "
Sand	930 "
Sand	965 "
Gray slate	994 "
Lime	997 "
Gray slate	1010 "
Lime	1033 "
Brown slate	1055 "
Sand	1078 "
Gray slate	1160 "
Lime	1178 "
Gray slate	1188 "
Sand	1192 "
Lime	1212 "
Gray slate	1217 "
Sand	1232 "
Gray slate	1237 "
Lime	1245 "
Gray slate	1260 "
Lime	1270 "
Brown slate	1280 "
Red rock	1283 "
Gray slate	1298 "
Sand	1307 "

Gray slate	to 1312	feet
Sand	1327	"
Brown lime	1335	"
Gray slate	1340	"
Sand	1345	"
Oil sand	1347	"
Total depth	1347	feet.

Estate of Michael Murphy (deceased) Oil Co. Well No. 5, S. T. Rumble farm, Madison Twp. Finished July 7, 1919. Dry.

Lime shell	80	to	85	feet.	
Coal	85	"	88	"	
Sandy lime	88	"	110	"	
Slate	110	"	130	"	
Lime	130	"	145	"	
Coal	145	"	150	"	Water
White slate	150	"	210	"	
Sandy lime	210	"	325	"	Water, 2 bbls.
Dark slate	325	"	420	"	per hour
Lime	420	"	425	"	
White slate	425	"	460	"	
Lime	460	"	470	"	
Broken lime	470	"	550	"	
White slate	550	"	625	"	
Dark slate	625	"	715	"	
Sand	715	"	750	"	More water
Slate	750	"	840	"	
Sandy lime	840	"	920	"	
Water sand	920	"	940	"	Salt water
Dark slate	940	"	1050	"	
Lime cave	1050	"	1075	"	
Water sand	1075	"	1110	"	
Lime	1110	"	1130	"	
Dark slate	1130	"	1160	"	
Sand	1160	"	1180	"	
Little lime	1180	"	1200	"	
Slate	1200	"	1220	"	
Lime and sand	1220	"	1250	"	
Dark slate	1250	"	1270	"	
Big lime	1270	"	1292	"	
Slate	1292	"	1302	"	
Red rock	1302	"	1310	"	
Slate	1310	"	1322	"	
Oil sand	1322	"	1332	"	Dry—Snyder sand
Lime	1332	"	1345	"	Oakland City Sand
Sand and lime	1345	"	1384	"	Water—brown

Casing Record.

12½ in.	21 feet.
10 "	150 "
8¼ "	840 "
8¼ "	1265 "

In Madison Township a well on the Thomas farm, Section 30, pumped 50 barrels from a depth of 1280 feet. The Bement Oil and Gas Co.'s No. 1 well on the L. C. Thomas farm, in the S. W. ¼ of the S. W. ¼ of section 32, is estimated at 50 to 100 barrels. The depth is 1170 feet.

Log of M. F. Snyder well No. 9, located in section 35, Madison Twp.:

Yellow clay	to	18	feet.
Sand	"	70	"
Brown slate	"	75	"
Coal	"	77	"
Brown slate	"	135	"
Lime	"	148	"
Gray slate	"	160	"
Lime	"	165	"
Gray slate	"	180	"
Brown slate	"	205	"
Coal	"	208	"
Lime	"	211	"
Brown slate	"	215	"
Lime	"	222	"
Gray slate	"	250	"
Brown slate	"	285	"
Lime	"	288	"
Brown slate	"	290	"
Gray slate	"	310	"
Brown slate	"	350	"
Gray slate	"	390	"
Brown slate	"	430	"
Sand	"	438	"
Brown slate	"	440	"
Lime	"	443	"
Brown slate	"	450	"
Gray slate	"	490	"
Brown slate	"	498	"
Lime	"	500	"
Coal	"	503	"
Gray slate	"	515	"
Lime	"	522	"
Brown slate	"	560	"
Gray slate	"	600	"
Brown slate	"	650	"
Gray slate	"	690	"
Sand	"	696	"
Brown slate	"	715	"
Gray slate	"	755	"

Sand	to	760	feet
Brown slate	"	800	"
Gray slate	"	820	"
Sand	"	830	"
Brown slate	"	858	"
Sand	"	872	"
Brown slate	"	880	"
Sand	"	940	"
Gray slate	"	948	"
Lime	"	950	"
Gray slate	"	955	"
Lime	"	965	"
Gray slate	"	1050	"
Sand	"	1060	"
Gray slate	"	1080	"
Sand	"	1160	"
Lime	"	1172	"
Gray slate	"	1200	"
Lime	"	1210	"
Gray slate	"	1220	"
Lime	"	1225	"
Gray slate	"	1230	"
Lime	"	1238	"
Gray slate	"	1258	"
Lime	"	1261	"
Gray slate	"	1265	"
Black slate	"	1275	"
Red rock	"	1277	"
Black slate	"	1313	"
Gas sand	"	1319	"
Brown shell	"	1325	"
Black slate	"	1340	"
Black lime	"	1342	"
Sand	"	1348	"
Total depth	"	1348	"

Casing Record.

12½	in.	70	feet.
10	"	442	"
8	"	948	"
6	"	1231	"
4⅝	"	1325	"

Well No. 1 on the F. P. Robling farm, 200 feet to South line, 200 feet to West line, Section 35, Madison Twp., Pike County:

Soil	to	1	feet.
Clay	"	11	"
White sand	"	51	"
Blue slate	"	90	"
White lime	"	100	"
Blue slate	"	140	"

Black slate	to	170	feet
Gray slate	"	190	"
White sand	"	200	"
Coal	"	202	"
Fire clay	"	210	"
Gray shale	"	255	"
White sand	"	325	"
Gray shale	"	330	"
White sand	"	355	"
Black slate	"	375	"
White sand	"	390	"
White shale	"	395	"
White lime	"	430	"
Black shale	"	450	"
Light slate	"	515	"
Coal	"	518	"
Light slate	"	563	"
Dark slate	"	598	"
Coal	"	600	"
Light slate	"	645	"
Light sand	"	655	"
Dark slate	"	660	"
Brown lime	"	665	"
Light sand (gas)	"	675	"
Dark slate	"	780	"
Gray sand	"	797	"
Gray slate	"	815	"
White sand	"	890	"
Dark lime	"	897	"
Dark slate	"	960	"
White shale	"	962	"
Brown sand (oil)	"	967	"
Gray sand	"	977	"
Brown sand (best pay)	"	992	"
Dark slate	"	1006	"
Gray sand	"	1022	"
Light sand	"	1028	"
Light sand	"	1119	"
Dark lime	"	1131	"
Blue mud	"	1134	"
Dark sand	"	1147	"
Dark lime	"	1152	"
White sand	"	1167	"
Brown lime	"	1176	"
Red rock	"	1179	"
Dark sand	"	1191	"
Dark slate	"	1197	"
White lime	"	1233	"
Dark slate	"	1270	"

Dark sand (show of oil)	to	1285	feet	
Dark sand	"	1292	"	
Dark lime	"	1294	"	
Light lime	"	1297	"	
Black slate	"	1302	"	
Light sand	"	1304	"	
Dark slate	"	1313	"	
Dark lime	"	1316	"	
Gray sand	"	1322	"	
Top of pay	"	1316	"	

Well No. 2, on the F. P. Robling farm, 333 feet to West line; 200 feet to North line, Section 35, Madison Twp., Pike County:

Black soil	to	1	feet.	
Yellow clay	"	6	"	
Brown mud	"	100	"	
Coal	"	104	"	
Gray lime	"	109	"	
Blue mud	"	129	"	
Gray shale	"	189	"	
Blue mud	"	204	"	
Gray lime	"	208	"	
White mud	"	253	"	
Brown shale	"	353	"	
White shale	"	403	"	
White lime	"	445	"	
Brown mud	"	545	"	
Gray lime	"	550	"	
White mud	"	640	"	
White lime	"	648	"	
Gray mud	"	678	"	
Brown shale	"	703	"	
Gray lime shell	"	710	"	
White mud	"	735	"	
Brown shale	"	755	"	
White sandy shell	"	760	"	
Gray slate	"	810	"	
Brown shale	"	885	"	
Blue shale	"	893	"	
White sand	"	903	"	
Blue slate	"	909	"	
White sand	"	926	"	
Gray lime	"	928	"	
Gray sand	"	943	"	
Black slate	"	950	"	
Gray lime	"	952	"	
Dark slate	"	1003	"	
Light slate	"	1021	"	
Gray sand	"	1029	"	Sand dry.
Dark slate	"	1035	"	

Gray lime	to	1039	feet
Same	"	1054	"
Dark lime	"	1059	"
White sand	"	1149	"
Gray lime	"	1164	"
Blue slate	"	1169	"
Gray lime	"	1177	"
Blue slate	"	1181	"
Gray lime	"	1185	"
Blue slate	"	1190	"
Gray lime	"	1202	"
Blue slate	"	1208	"
Gray lime	"	1220	"
Blue slate	"	1237	"
White lime, top of big lime	"	1240	"
Dark lime	"	1245	"
White lime	"	1250	"
Dark gray lime	"	1275	"
Red rock	"	1280	"
Dark slate	"	1292	"
Gray lime	"	1302	"
Dark lime	"	1317	"
Black lime	"	1323	"
Brown shell	"	1326	"
Dark slate	"	1330	"
Gray sand	"	1335	"
Dark slate	"	1343	"
Gray sand	"	1348	"
Top of pay sand	"	1343	"

Well No. 3, on the farm of F. P. Robling, 200 feet to East line, 400 feet S. E. Well No. 2, Section 35, Madison Township, Pike County:

Soil	to	1	feet.
Yellow clay	"	6	"
Dark slate	"	100	"
Coal	"	104	"
Gray lime	"	109	"
Dark slate	"	134	"
White lime	"	154	"
Dark slate	"	209	"
Gray lime	"	213	"
Light slate	"	258	"
Dark slate	"	308	"
Gray sand	"	323	"
Light slate	"	343	"
Dark lime	"	353	"
Dark slate	"	393	"
Black slate	"	398	"
Light slate	"	435	"
Gray lime	"	450	"

Light slate	to	465	feet
Gray slate	"	485	"
Light slate	"	495	"
Gray lime	"	500	"
Light slate	"	505	"
White lime	"	525	"
Light slate	"	540	"
Coal	"	545	"
Dark slate	"	560	"
Brown lime	"	565	"
Dark slate	"	595	"
Light slate, 8¼" set at 635'	"	645	"
Brown lime	"	650	"
Dark slate	"	700	"
White sand	"	715	"
Dark slate	"	720	"
White lime	"	750	"
Dark slate	"	790	"
Brown slate	"	850	"
Light slate	"	890	"
White sand, hole full of water	"	923	"
Light slate	"	926	"
White sand	"	931	"
Dark slate	"	953	"
Brown lime	"	958	"
Dark slate	"	1015	"
Brown sand	"	1030	"
Dark slate	"	1045	"
Dark slate	"	1050	"
Brown lime	"	1055	"
Light sand, hole full of water 1060	"	1160	"
Gray lime	"	1168	"
Dark slate	"	1173	"
White lime	"	1180	"
Dark slate	"	1185	"
Gray lime	"	1205	"
Light slate	"	1212	"
White lime	"	1216	"
Dark slate	"	1220	"
White lime	"	1223	"
Dark slate	"	1234	"
Brown lime	"	1259	"
Light slate	"	1279	"
Light mud	"	1289	"
Dark lime	"	1305	"
Dark slate	"	1315	"
Dark sand	"	1320	"
Dark lime	"	1327	"
Dark slate	"	1340	"

Gray lime		to	1342 feet
Gray sand		"	1346 "
Pay sand	1342	"	1346 "

Well Record No. 4, C. Burkhart farm, Section 35, Madison Township:

Soil	to	8 feet.
Mud	"	16 "
Sand	"	28 "
Water sand	"	40 "
Slate	"	70 "
Black slate	"	90 "
Coal	"	95 "
Lime	"	105 "
Slate	"	110 "
Mud	"	190 "
Slate	"	220 "
Coal	"	227 "
Slate	"	280 "
Sand	"	300 "
Slate	"	305 "
Sand	"	335 "
Lime	"	340 "
Slate	"	385 "
Sandy lime	"	405 "
White slate	"	410 "
Black slate	"	435 "
White slate	"	440 "
Lime	"	445 "
Black slate	"	450 "
White slate	"	460 "
Lime	"	465 "
Black slate	"	480 "
White slate	"	560 "
Black slate	"	580 "
Lime	"	585 "
White slate	"	615 "
Water sand	"	650 "
Black slate	"	680 "
Water sand	"	705 "
Black slate	"	735 "
White slate	"	750 "
Black slate	"	775 "
Sand	"	790 "
Black slate	"	820 "
Sand	"	870 "
Sandy lime	"	880 "
Water sand	"	900 "
Black slate	"	920 "
White slate	"	930 "
Black slate	"	975 "

Lime	to	979 feet
Oil sand	"	1007 "
Total depth	"	1024 "

Washington Township. Two oil sands are reported from this township at depths ranging from 1110 to 1226 feet. The following is the log of a well completed Sept. 27, 1919, on the J. R. Chew farm, Section 32, Pike County:

Surface	to	45 feet.
Sand rock	"	55 "
Slate	"	105 "
Lime shell	"	110 "
Coal	"	112 "
Slate	"	170 "
Sand	"	180 "
Slate	"	240 "
Lime	"	245 "
Coal	"	247 "
Slate	"	317 "
White mud	"	367 "
Slate	"	383 "
Sandy shale	"	470 "
Sand	"	525 "
Slate	"	550 "
Sand	"	590 "
Slate	"	630 "
Water sand	"	680 "
Dark slate, mud	"	710 "
Sand	"	725 "
Dark slate	"	770 "
Lime shell	"	815 "
Sand	"	868 "
Sandy lime	"	876 "
Broken slate	"	877 "
Little lime	"	887 "
Light slate	"	920 "
Light lime	"	935 "
Sand	"	959 "
Lime	"	962 "
Slate	"	965 "
Big lime	"	1001 "
Slate	"	1036 "
Shell	"	1039 "
Slate	"	1041 "
Oakland City sand	"	1050 "
Slate	"	1053 "
Oakland City sand	"	1061 "
Brown lime	"	1071 "
Slate	"	1081 "

Oil sand	to	1094	feet
Hard shell	"	1095	"
Broken sand	"	1107	"
Brown oil sand	"	1109	"
Total depth	"	1109	"

Log of Rogers well, Rogers Station, E. & I. R. R.:

Common top sand	to	25	feet.
Shale and limestone shells	"	90	"
Streak of soft sand	"	115	"
Soft muddy shale	"	140	"
Coal and black shale	"	150	"
White sand and black shale	"	160	"
Streaks of very sharp sand	"	187	"
White sand	"	200	"
White and limestone shells	"	220	"
Shale	"	230	"
Shells	"	247	"
Coal	"	250	"
Caving slate and shale	"	260	"
Sand, small flow of gas on top	"	290	"
Black shale	"	320	"
Limestone and shale	"	360	"
Shale	"	375	"
Limestone, shells and slate	"	460	"
Sand shells	"	470	"
Sand	"	505	"
Limestone, shells and slate	"	560	"
Sand, shells and slate	"	600	"
Straight salt sand	"	692	"
Straight limestone	"	885	"
Limestone	"	900	"
Sandstone and slate	"	920	"
Sand and limestone	"	945	"
Sand with small streaks of slate	"	992	"
Streak of red marl	"	994	"
Case brick penal cave	"	1008	"
Slate and sand oil	"	1027	"
Sand	"	1057	"
Slate	"	1075	"
Sand and limestone	"	1161	"
Limestone	"	1185	"

Report on Oil.

24 Degrees gravity
20 Degrees cold test
300 Degrees fire test
504 Vis. at 70 degrees

Section 28, Washington Township:

13 inch drive pipe	57	feet.
10 inch drive pipe	124	"
8¼ inch casing pipe	791	"
6¼ inch casing	1075	"
Top of gas sand	1162	"

Drilled in three feet. Tested 3,162,000 cubic feet capacity. Completed March 24, 1909. One well has been abandoned in Section 19, 3 in Section 27, 3 in Section 28 and 1 in Section 30.

A. B. Bement's No. 10, on the L. C. Thomas farm, Section 32, Washington Township, pumped 20 barrels from the brown sand. The top of the sand was struck at 1123 feet and drilled to a total depth of 1138 feet.

Monroe Township. Record of the Yeager No. 1 well, N. E. ¼ of the S. W. ¼ of Section 26, Monroe Township:

Surface, mud, loam and quick sand	52	feet.
Coal measures, shale, coal, etc	408	"
Sandstones (Mansfield and Huron)	410	"
Limestone	30	"
Shale	15	"
Limestone	40	"
Shale	10	"
Limestone	70	"
Shale	5	"
Limestone	54	"
Shale	46	"
Limestone and shale	41	"
Total depth	1181	"

The following wells have been abandoned: Section 21, 6 wells; Section 22, 1 well; Section 23, 9 wells; Section 24, 1 well; Section 26, 6 wells; Section 27, 2 wells; Section 28, 3 wells; Section 30, 1 well; Section 35, 4 wells.

Logan Township. Two oil pools are located in this township, the Union and the Oatsville. The following is the record of a well from the Oatsville pool. A second well drilled on this lease reported oil at 1320 feet. Drilled July 17, 1919.

Well No. 1, John Cornelius Farm, Section 27.

Surface clay	to	25	feet.
Blue slate	"	50	"
Shell, first water	"	55	"
Slate	"	80	"
Sand	"	135	"
Lime	"	145	"
Black slate	"	155	"
Sand	"	175	"
Sandy shale	"	200	"

Lime and coal	to	210	feet
White lime	"	220	"
White slate	"	265	"
Black slate	"	285	"
Sandy slate	"	320	"
Sandy slate	"	330	"
White slate	"	360	"
Coal	"	366	"
Slate	"	415	"
Lime	"	420	"
Slate	"	485	"
Lime	"	489	"
Slate	"	540	"
Sandy lime	"	600	"
White slate	"	630	"
Black slate	"	675	"
Sandy lime	"	745	"
Slate	"	795	"
Salt water sand	"	900	"
White slate	"	935	"
Sand hard	"	949	"
Sandy slate	"	956	"
Black slate	"	999	"
Coal	"	1000	"
Black slate	"	1010	"
Sand	"	1116	"
Blue slate	"	1126	"
Gray lime	"	1146	"
Blue slate	"	1177	"
Lime	"	1232	"
Blue slate	"	1239	"
Gray lime	"	1244	"
Slate broken	"	1269	"
Sand top	"	1269	"
First oil	"	1275	"
Coarse brown sand	"	1281	"
Fine white sand	"	1292	"

Show water in last foot.

One well in Section 27 and another in Section 35 were abandoned.

In the Union field oil sands are reported at depths ranging from 1,070 to 1,774 feet.

Patoka Township. A large number of wells have been drilled in this township. Wells have been abandoned as follows: Section 11, 7 wells; Section 13, 2 wells; Section 14, 18 wells; Section 15, 1 well; Section 18, 1 well.

Lockhart Township. One well was drilled in Section 5 and one in Section 21.

Clay Township. One well was abandoned in Section 3 and one in Section 32.

Jefferson Township. Wells were drilled in Sections 4, 8 and 31.

PORTER COUNTY

Devonian strata probably underlie the whole of Porter County, though it is possible that preglacial streams may have been cut through to the Silurian. The eroded surface of the Devonian is covered with glacial drift which attains a thickness of 200 feet or more. The record of a well drilled at Valparaiso is given by Phinney[1] as follows:

Drift	125	feet.
Black shale	65	"
Corniferous, lower Helderburg & water	230	"
Niagara limestone	380	"
Niagara shale	5	"
Clinton limestone	55	"
Bluish-green Hudson River shales	160	"
Chocolate-brown limestone (galena)	256	"
Trenton limestone	68	"
Total depth	1344	"
Altitude of well	715	"

Another well reported by Gorby[2] for the same place is recorded below:

Section of Well No. 1.

Drift	125	feet.
Hamilton shale	65	"
Corniferous limestone	55	"
Niagara limestone	565	"
Clinton (?) limestone	10	"
Hudson River limestone and shale	185	"
Utica shale	295	"
Trenton limestone	144	"
Total depth	1444	"
Trenton below sea level	602	"

The surface of the Trenton appears to dip northward through this county at the rate of about twenty feet to the mile.

POSEY COUNTY

Posey County lies within the area of outcrop of strata of the Pennsylvanian age. As it lies between the Wabash and Ohio Rivers, a goodly portion of its area is covered with alluvium. A somewhat larger area is mantled with glacial drift, though a portion of the county is unglaciated. With the exception of the river valleys, outcrops are not wanting in many parts of the county. Careful detailed work will probably reveal the

structural conditions favorable to the accumulation of oil and gas if such exist. The coal beds and beds of limestone will probably be the most useful keys for unlocking structure.

The following is the record of a well drilled at Mt. Vernon[1]:

Yellow clay	27 feet.	
Brown soapstone	44 "	
White sandstone (Merom)	32 "	
Coal		2 inches.
Limestone with streaks of clay	4 "	
Blue shale	7 "	
Coal	1 "	
Fire clay	5 "	
Sulphur mixed with fire clay	3 "	
Soapstone	3 "	
Dark blue shale	25 "	
Limestone	7 "	
Coal		2 inches.
Dark shale	25 "	
Sandstone		6 inches.
Soapstone	22 "	6 inches.
Sandstone	5 "	6 inches.
Sandstone and shale, about every alternate foot	19 "	
Coal	6 "	
Shale streaked with sandstone	5 "	6 inches.
Soapstone	10 "	
Dark shale	17 "	6 inches.
Black coal shale	3 "	
Coal		4 inches.
Blue fire clay	12 "	
Dark fire clay	13 "	
Sandstone	3 "	
Shale streaked with sand	4 "	6 inches.
Blue shale with small white streaks	46 "	
Soft dark blue shales	46 "	6 inches.
Black shale	1 "	
Bastard shale	1 "	6 inches.
Rock		6 inches.
Coal	1 "	3 inches.
Fire clay	7 "	3 inches.
Soapstone	7 "	3 inches.
Total depth	407 "	

Point Township. A deep well was drilled in Section 2 on the property of W. E. Hastings, and was plugged in 1913. No record of this well was obtained.

[1]Ashley, Coal Report, 1898, p. 1416.

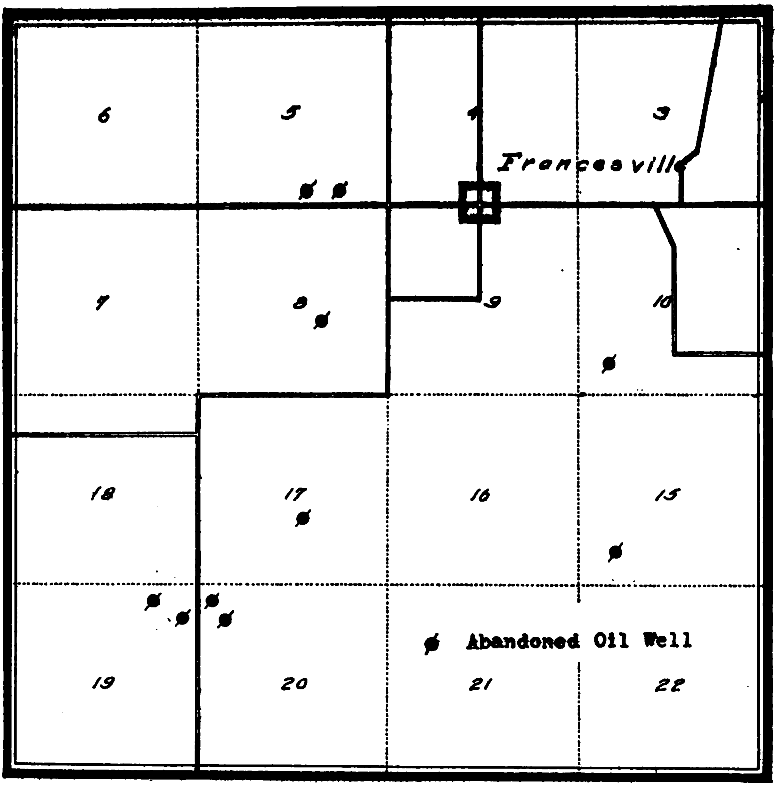

Fig. 57. Map showing the location of oil wells in the Francesville oil field in Pulaski County.

PULASKI COUNTY

Silurian and Devonian strata underlie the glacial drift in Pulaski County. Gas was found in some wells drilled at Francesville. The record of the first well drilled is given below:

Section of Well No. 1.

Drift	8	feet.
Niagara limestone	542	"
Hudson River limestone and shale	235	"
Utica shale	100	"
Trenton limestone	10	"
Total depth	895	"
Trenton below sea level	200	"

Yielded a small quantity of gas.

The concealment of the bedrock strata by the glacial drift prevents the determination of the structural conditions so that it is impossible to

say whether structures favorable to the accumulation of oil and gas exist in other parts of the county or not. The surface of the Trenton in the southern part of the county is about 200 feet below sea level and the depth increases to more than 400 feet in the northern portion of the county.

Railroad Elevations.

Boone, 725.1; Thornhope, 710.8; Star City, 697.7; Winamac, 700.3; Monterey, 714; Francesville, 680; Medaryville, 688.1; Clarks, 705.4: Anthonys, 706.6; Lawton, 713; Beardstown, 713.

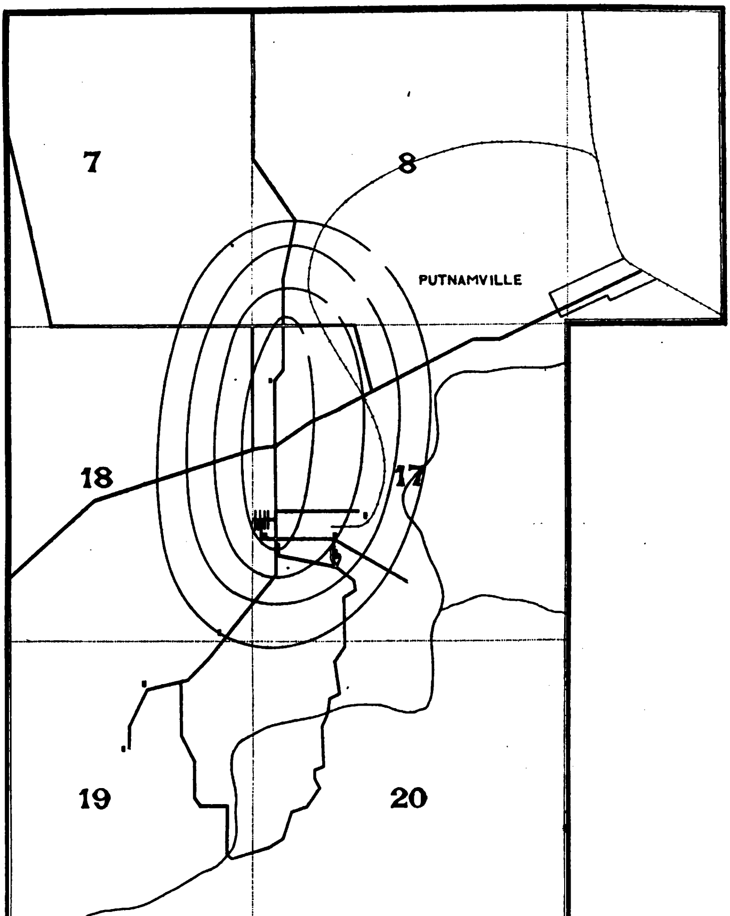

Fig. 58. Map showing outline of small anticline on the State Farm near Putnamville. Contours on the surface of limestone.

PUTNAM COUNTY

The glacial drift in Putnam County is thin so that the bed rock is exposed in many places. The drift is of greater thickness in the northern part of the county than in the southern part and consequently the outcrops of the bed rock are more numerous in the latter. The rocks underlying the drift belong to the Knobstone, Warsaw, Salem, Mitchell, and Chester divisions of the Mississippian and Pottsville (Mansfield) and coal measures (Allegheny) divisions of the Pennsylvanian. In the southern part of the county in the region occupied by the Chester and the Pennsylvanian divisions the structural conditions may be determined. A small structure has been outlined by the writer on the State Farm and others may exist in the county.

A well was drilled in Section 28 of Russell Township to a depth of 800 feet. It probably encountered the Corniferous limestone in the Devonian at which point a strong flow of salt water and a slight showing of gas were encountered.

A well at Reelsville in Washington Township at an elevation of 600 feet above sea level penetrated the Niagara limestone at 1240 feet and secured an artesian supply of salt water.

Bainbridge. A well was drilled on the Miller farm, one and one-half miles west of Bainbridge, to a depth of 1647 feet, a little oil was obtained at 1450 feet. This was evidently in the Trenton, the surface of which must be about 1400 feet or a little below.

Several wells have been drilled around Greencastle, but no records have been obtained.

RANDOLPH COUNTY

This county lies within the glaciated area where the drift is from 25 to 150 feet thick. The drift rests upon the eroded surface of the Niagara. The concealment of the bed rock prevents the determination of the structural conditions favorable to the accumulation of oil.

White River Township. The first well drilled in Winchester passed through the following strata[1]:

Drift	147	feet.
Niagara limestone	110	"
Niagara shale	40	"
Hudson River	430	"
Utica shale	330	"
Trenton limestone	20	"
Total depth	1077	"

Trenton below sea level, 24 feet. A feeble flow of gas and a few barrels of oil were obtained. A second well drilled one mile north of No. 1 found the Trenton 38 feet higher, well shot, only a feeble flow of gas. No. 3 was drilled one-fourth mile northeast of No. 2, and the Trenton found 72 feet above sea level, well shot, flow feeble. No. 4, located west of No. 1,

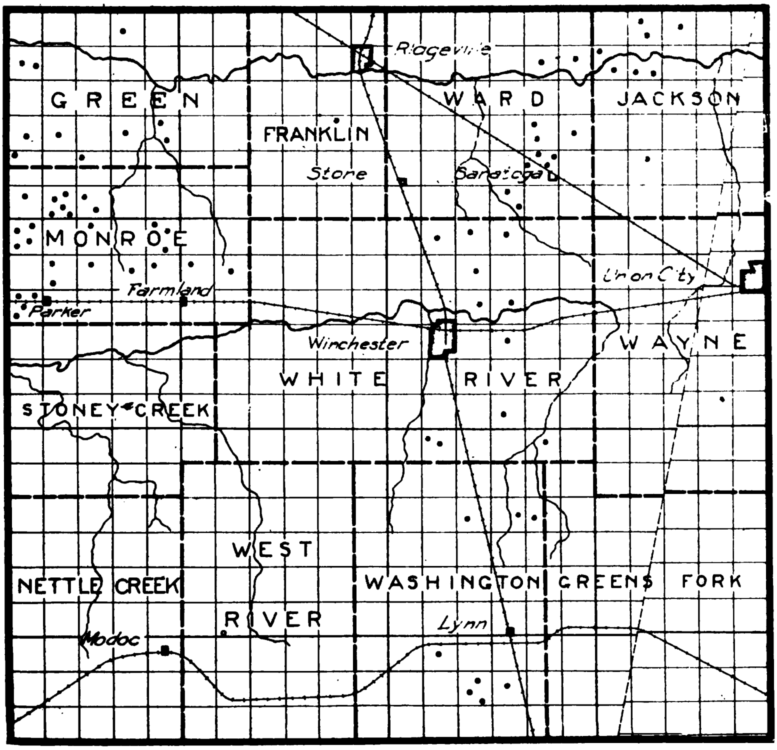

Fig. 59. Map of Randolph County showing location of recorded abandoned wells. The western part of Green and Monroe Townships is oil territory and the western part of Stony Creek and Nettle Creek is gas territory.

yielded a little gas and oil, as did No. 5, located east of No. 3. No. 6, located three-quarters of a mile northeast of Winchester, reached the Trenton at 1044 and yielded gas at 1056 to 1060. No. 7, located sixty rods southeast of No. 6, reached the Trenton at 1036 feet and gas between 1060 and 1071. No. 8, located one-half mile northeast of No. 7, was dry. No. 9, located forty rods north of No. 7, gave a good flow. No. 10, located south of No. 7, produced 1,500,000 cubic feet per day.

Wells drilled on the Prickett farm in Section 23, southeast of Winchester, produced 20 barrels of oil per day.

Record of Prickett Wells.

Drive pipe	85 feet.
Casing	226 "
Top of Trenton	1091 "
Total depth	1156 "

Wells drilled on the Eliza Goodrich farm, near Winchester, produced a small amount of oil and gas. The records of two of these wells are as follows:

	No. 7	No. 8
Drift	102 feet.	70 feet.
Niagara limestone	85 "	110 "
Hudson River	549 "	520 "
Utica shale	300 "	332½ "
Trenton limestone	49 "	51½ "
Total depth	1085 "	1084 "

Wells have been plugged in this township as follows: Section 2, 1 well; Section 3, 1 well; Section 4, 1 well; Section 5, 1 well; Section 9, 2 wells; Section 15, 1 well; Section 16, 1 well; Section 22, 1 well; Section 27, 1 well; Section 32, 1 well; Section 35, 1 well.

Monroe Township. Seven wells were drilled at Farmland. Four produced some gas. A section of well No. 1 is given below:

Farmland Well No. 1.

Drift	55 feet.
Niagara limestone	160 "
Hudson River	585 "
Utica shale	185 "
Trenton limestone	32 "
Total depth	1017 "
Trenton above sea level	55 "

Oil was found in this township in Sections 3, 4, 5, 8, 9, 10, 11, 15, 16, 17, 21, gas in 9 and 27. Wells abandoned are located in: Section 1, 3 wells; Section 3, 1 well; Section 5, 4 wells; Section 7, 1 well; Section 8, 1 well; Section 9, 2 wells; Section 10, 1 well; Section 12, 1 well; Section 13, 1 well; Section 15, 1 well; Section 17, 4 wells; Section 32, 1 well; Section 33, 5 wells; Section 34, 2 wells.

Stony Creek Township. Oil was obtained from Sections 19 and 30. The record of a dry hole in Section 32 is given below:

Drive pipe	64 feet.
Casing	320 "
Top of Trenton	956 "
Total depth	307 "

Greene Township. Oil was found in Sections 20, 28, and 29. Wells have been plugged in Sections 2, 1 well; Section 6, 1 well; Section 8, 2 wells; Section 20, 1 well; Section 21, 1 well; Section 23, 1 well; Section 24, 2 wells; Section 27, 1 well; Section 29, 1 well; Section 35, 1 well.

Section 1, R. 12 E., Greene Township.

Top soil	42 feet.
Lime	220 "
Shale	694 "

Drilled 446 feet into Trenton.

Total depth	1402	"
Dry hole. Showing of oil very good at	1066	"
Showing of sand favorable for oil	1250	"

Well shot. No good results.

Section 26, T. 21 N., R. 11 E., J. W. Bartlett Farm.

Top soil	46	feet.
Lime	280	"
Shales	632	"
Trenton at	958	"
Into Trenton	145	"
Total depth	1103	"
Oil showing at	975	"
Good oil showing at	1103	"

Franklin Township. At Ridgeville three dry holes were drilled. The Trenton was reached at 981, 2 feet above sea level. A well was drilled and abandoned in Section 23, on the J. M. Addington property, in 1919.

Wayne Township. A little gas was found at Union City. Four wells were drilled. In well No. 4, north of the city, the Trenton was reached at 1093 and is 83 feet below sea level. The record of the first well kept by A. Jaqua is as follows:

Union City Well No. 1.

Drift	98	"
White limestone (Niagara)	72	"
Dark gray limestone	62	"
Bluish limestone	38	"
Niagara shale	40	"
Clinton (?) limestone	15	"
Bluish-green shale	400	"
Gray shale	175	"
Brown shale	175	"
Black shale	80	"
Trenton limestone	525	"
Gray sandstone (St. Peter)	100	"
Total depth	1780	"
Altitude of well	1079	"

Another well at Union City yielded traces of gas between depths 1155 and 1162 feet. The record of this well follows:

Union City Well.

Drift	98	"
Niagara limestone	250	"
Hudson River and Utica	800	"
Trenton limestone	540	"
Total depth	1688	"
Trenton below sea level	40	"

Nettle Creek Township. A well was drilled at Losantsville and after passing through 173 feet of drift and 821 feet of rock the Trenton was reached at 994 feet. The total depth was 1105 feet. No oil, gas or water was found in the Trenton. The top of the Trenton is 146 feet above sea level.

Washington Township. Abandoned wells are located in this township as follows: Section 5, 1 well; Section 9, 3 wells; Section 10, 1 well; Section 14, 1 well; Section 15, 1 well; Section 16, 1 well.

Jackson Township: Wells have been abandoned in this township as follows: Section 4, 1 well; Section 5, 2 wells; Section 7, 2 wells: Section 8, 2 wells; Section 29, 1 well.

Ward Township. Abandoned wells are located as follows: Section 11, 1 well; Section 12, 1 well; Section 23, 2 wells; Section 24, 1 well; Section 26, 4 wells; Section 34, 2 wells.

RIPLEY COUNTY

The geological formations represented by outcrops in this county are given below:

Quaternary	Recent, Alluvial sands and clays. Pleistocene, glacial gravel, sands and till.
Devonian	Limestones.
Silurian	Limestones and shales.
Ordovician	Shales and limestones.

The Pleistocene covering the bed rock varies from a few feet to fifty feet in thickness and rests on the eroded surface of the bed rock. The latter outcrops at many points so that it may be possible to determine the structural conditions by surficial observations.

The surface of the Trenton is about sea level in the eastern part of the county and lies probably as much as 150 feet below in the western part of the county. If the structural conditions are favorable there is a possibility of oil or gas accumulations in the Devonian and the Trenton strata.

Railroad Elevations.

Milan, 1,007; Pierceville, 1,007; Osgood, 990; Dabney, 966; Holton, 923; Sunman, 1,016.6; Morris, 997.5.

RUSH COUNTY

Rocks belonging to the Devonian and Silurian periods form the bed rocks of this county. The glacial drift lies upon the surface of these formations to a depth of from 50 to 100 feet and prevents the determination of structural conditions.

Rushville Township. At Rushville three wells obtained gas. The record of well No. 1 is given below:

Drift	60	feet.
Chert and cherty limestone (Corniferous)	40	"
Niagara limestone and shale	200	"
Hudson River limestone and shale	200	"
Utica shale	360	"
Total to Trenton	860	"
Trenton above sea level	124	"

From drillings preserved by G. W. Clark, Phinney constructed the following record of one of the wells:

Drift	48	feet.
White limestone	42	"
Blue limestone	30	"
Gray limestone (Clinton)	5	"
Hudson River limestone and shale	420	"
Utica shale	262	"
Gray limestone	25	"
Brown limestone, Trenton	35	"
White limestone	30	"
Total	922	feet.
Altitude of well.	996	"

Union Township. At Glenwood the top of the Trenton was reached at 950 feet, or 166 feet above sea level.

A well at Milroy in Anderson Township was unproductive.

Ripley Township. A log of a well drilled at Carthage is as follows:

Drift	50	feet.
Limestone	100	"
Shale	670	"
Trenton limestone	20	"
Total depth	840	"

Wells drilled and abandoned in this township are as follows:

Owner.	Section.	Date.	Wells.
J. Phares	10	1912	1
F. K. Mull	15	1912	1
W. P. Stanley	18	1912	1
V. Robertson	20	1913	1
Benton Henley	25	1912	1
Noah Moore	27	1916	1
J. Vasbinder	6	1911	1
Jabez Reddick	28	1912	1
J. H. Powers	34	1911	1
John Swain	34	1912	1
Wm. Dille	35	1913	1

Washington Township. A large number of wells were drilled in this township. The following have been abandoned: Section 1, 3 wells; Section 3, 1 well; Section 14, 1 well; Section 33, 1 well; Section 4, 3 wells; Section 5, 2 wells; Section 16, 2 wells; Section 34, 1 well; Section 7,

6 wells; Section 8, 3 wells; Section 22, 1 well; Section 9, 2 wells; Section 11, 5 wells; Section 26, 2 wells; Section 12, 2 wells; Section 13, 1 well; Section 32, 1 well.

Jackson Township. Wells were drilled and abandoned in the following Sections: 5, 6, 10, and 20, one well each.

Posey Township. A well drilled in Section 4 was abandoned in 1911, on J. Piper property.

Walker Township. A well on the Tillie Trees property in Section 15 was abandoned in 1913.

SCOTT COUNTY

The geological formations outcropping in this county belong to the Devonian, Mississippian, and Quaternary periods. The divisions represented are given below:

Quaternary	Recent—Clays and alluvium. Pleistocene—Sands, gravels and till.
Mississippian	Knobstone—Shales and sandstones. Rockford—Limestones.
Devonian	New Albany—Shales. Sellersburg—Limestones. Silver Creek—Limestones. Jeffersonville—Limestones.

Because of the removal of much of the regolith, outcrops of the durolith are perhaps numerous enough to permit the determination of the structural conditions for the greater part of the county. The best key horizon will be the contact between the Sellersburg limestone and the New Albany shales for the eastern part of the county and the Rockford limestone for the western part.

Three deep wells were drilled in this county in search of oil, but no production was obtained and the records of the wells were not obtained.

Railroad Elevations.

Blocher, 677; Lexington, 620.

SHELBY COUNTY

The drift in Shelby County varies in thickness from 50 to 150 feet and overlies Devonian limestones and shales. There are a few outcrops of Silurian rocks in the southeastern part of the county.

Addison Township. According to Phinney[1] five wells were drilled in the vicinity of Shelbyville. He gave the following general section:

Drift	45	feet.
Limestone	265	"
Shale	527	"
Trenton limestone	100	"
Total depth	937	"
Altitude of well	772	"

Logs of the first two wells drilled at Shelbyville are given below:

	No. 1	No. 2
Drift	48 feet.	80 feet.
Corniferous limestone	30 "	......
Niagara limestone	102 "	769 "
Hudson River limestone and shale	657 "	......
Trenton limestone	86 "	......
Total depth	923 "	849 "
Trenton below sea level	79 "	......

Hanover Township. At Morristown a well drilled on the Chas. F. Muth farm was reported by Phinney[1] as in No. 1 below and by Gorby[2] as in No. 2.

	No. 1	No. 2
Drift	140 feet.	140 feet.
Limestone	20 "	......
Niagara	120 "	130 "
Hudson River & Utica shale	638½ "	628 "

Two wells were abandoned in Section 1, three in Section 17, and one in Section 18. The Trenton was reached at St. Paul in Noble Township at 820 feet. The thickness of the drift is 90 feet and the altitude is 844 feet.

Marion Township. A well drilled on the S. A. Haven property in Section 6 was abandoned in 1911.

Union Township. A well drilled on the property of H. W. & J. W. Moore was abandoned in 1911, and one on the property of Charles Brown in Section 17 in 1913.

Van Buren Township. Wells drilled on the property of Walter Hadley and Elias Miller in Section 17 were abandoned in 1913.

SPENCER COUNTY

The strata occupying almost the whole of the surface of Spencer County belong to the Allegheny division of the Pennsylvanian, though some outcrops of the Pottsville probably occur on the banks and in the bed of the Anderson River, which forms the eastern boundary. The rocks are sandstones, shales, and limestones with intercalated beds of coal. Three divisions of coal occur in the county. It is possible that coal and some of the associated limestones may prove valuable as key formations by the use of which the structure may be determined. Gas has been found in the county in Jackson Township, near Graysville.

The following is a record of the well drilled on the Fred Frakes farm, Section 3, R. 6 W., Jackson Township, near Gentryville, Spencer County:

10-inch drive pipe	80 feet.
8-inch drive pipe	400 "
Showing of oil	720 "
6¼-inch casing	900 "
Gas sand	990 "
Finished	1025 "

Capacity of first twenty-four hours, 1,000,000 cubic feet. A well was drilled in Section 1 of this township in 1913, three miles east of Graysville. Two dry holes were drilled in 1916.

Harrison Township. A well was drilled north of St. Meinrad in Section 12 in 1913 without securing production.

Railroad Elevations.

Dale, 432.0; Lincoln City, 459.0; Gentryville, 413.0; Pigeon 403.0; Lincolnville, 459; Buffaloville, 427; Lamars, 411; Evanston, 413; Bradleys, 460; Chrisney, 447; Millers, 423; Ritchies, 409; Rock Hill, 400; Rockport, 380.

STARKE COUNTY

This county lies on the north side of the extension of the Cincinnati arch passing through Indiana. Its bedrock strata consist of limestones and shales of Devonian age. On the eroded surface of these rocks there has been deposited an overburden of glacial drift which attains a thickness of several hundred feet. Because of the covering of glacial drift the structural conditions existing in the bed rock of this county cannot be determined by direct observation. If a sufficient number of deep well records could be obtained, the structures might be determined. Until such records are available the location of structures favorable to the accumulation of oil and gas cannot be located if such exist in the county.

The surface of the Trenton lies between 250 and 500 feet below sea level in this county, being nearer sea level in the southern part of the county.

Railroad Elevations.

Hamlet, 702; Knox, 702; Toto, 703; North Judson, 697; San Pierre, 704; Grovertown, 719.8; Davis, 681.7; Ora, 718; Bass Lake Jct., 711; Aldine, 715.

ST. JOSEPH COUNTY

The strata of the Devonian age underlie the glacial drift of this county. The glacial drift reaches a thickness of one hundred and fifty or more feet. The dip of the bed rock is toward the north.

The section of a well in South Bend constructed from drillings furnished Phinney[1] by J. D. Oliver is as follows:

Drift sand and gravel	137	feet.
Waverly shale (bluish green, calcareous)	143	"
Black shale	70	"
Brown shale	25	"
Gray limestone upper (Helderburg)	60	"
Blue limestone	20	"
Lower Helderburg, with gypsum	170	"
Water lime	55	"
Niagara limestone (gray buff & white)	470	"
Buff Clinton limestone	30	"
Hudson River limestone and shale	220	"

Utica shale	183	"
Trenton limestone (chocolate colored)	85	"
Total	1670	feet.
Altitude of well	725	"

Salt water was encountered at 375, 610 and 1670 feet.

The record of a well drilled on the Studebaker farm follows[2]:

Drift	160	feet.
Sub-Carboniferous and Hamilton shale	220	"
Corniferous limestone	60	"
Lower Helderburg limestone	40	"
Niagara limestone	640	"
Clinton (?) limestone	60	"
Hudson River and Utica	420	"
Trenton limestone	427	"
Total depth	2027	feet.
Trenton below sea level	855	"

Yielded no gas or oil.

The structural conditions of the durolith in this county cannot be determined by direct observation because of the glacial drift which conceals the outcrop of the strata. The surface of the Trenton lies from 600 to 1,000 feet below sea level.

STEUBEN COUNTY

The strata underlying the glacial drift in Steuben county belong to the Mississippian and the Devonian periods of geological times. The bed rock formation consist of shales and limestones. The outcrops of these rocks are concealed by a thick mantle of glacial drift which was deposited on their eroded surface and attains a total thickness of several hundred feet. The dip of the bedrock is toward the north away from the westward extension of the Cincinnati arch through Indiana. Because of the glacial drift the structural and the stratigraphical conditions of the bedrock can not be determined by surficial methods of observation. Deep well records are not at present available for the determination of the structure by the use of subsurface data. Prospecting for oil and gas in this county, for the above reasons, will prove extremely hazardous.

The surface of the Trenton probably lies between 1,500 and 2,000 feet below sea level in this county, being nearer the surface in the southern part.

Railroad Elevations

Hamilton, 926; Ashley, 999; Fredrick, 972.2; Helmer, 986; Steubenville, 991; Pleasant Lake, 976.1; Angola, 1055.3; Fremont, 1058.1; Ray, 1077.8.

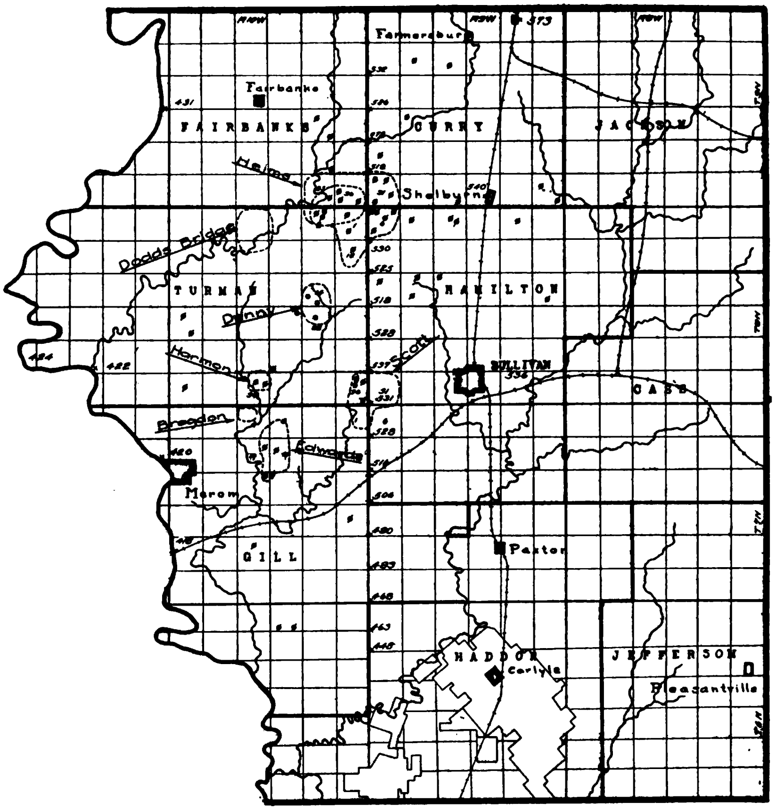

Fig. 60. Map of Sullivan County showing the location of the oil fields.

SULLIVAN COUNTY

(By Dr. S. S. Visher)

Location. There are seven major pools or oil fields producing at present in Sullivan County. These pools are about 30 miles south of Terre Haute, in the Wabash Valley. They are within a few miles of Sullivan, northwest, west and southwest. Their combined area is about twelve square miles. The location of the pools is shown on the accompanying map on which the elevation of numerous points is also shown.

Production. The present production is about 380 barrels per day. Widespread production commenced in August 1913; it became considerable in 1914, reaching 3,000 barrels a day by June 1st; increased somewhat in 1915 and reached a maximum in that year. Since 1915 it has declined somewhat steadily, in spite of the opening of two new pools and the bringing in of a number of producers in the older pools. The daily production, when greatest, was about 3,500 barrels per day, or nearly three times the present production.

Number of Wells. October 1, 1919 about 480 wells were being pumped. More than 1,000 wells have been sunk for oil in the county. (Four hundred between April 1, 1913 to June 1, 1914, of which 225 were producers, according to Barrett.) Probably more non-producing wells have been drilled in the county than producers. Every month a few wells formerly pumped are abandoned, because it no longer pays to pump them. Two outfits are at present engaged in drilling new wells. Before the war, several outfits were kept busy thus. New producers are added to the total of producers every month, but more wells are abandoned than added, so that the number of producing wells is decreasing, and has been for the last two or three years. The decrease in production is greater than the decrease in the number of wells, however, the declining yield of the existing wells, being the cause.

The average production per well is already distinctly less than a barrel per day. Many wells yielded 20 barrels their first day, and some yielded 100 to 150 and a few somewhat more. At present, many wells yield as little as one-fourth barrel. With the present high price of oil, a producer is not abandoned until it yields less than that, unless it needs recasing.

The presence of 480 wells in an area of 12 square miles, means that on the average there are 40 wells per square mile. In the better parts of the 12 square miles, the wells are drilled only 400 or 460 feet apart, 9 on each 40 acres; wells being drilled 200 feet from the outside lines of the 40 and on a central row where each well is 460 feet from another of the tract. Nine wells on a 40, is at the rate of 144 per square mile.

"Wild-catting" is the only method known in this area to discover new pools. Wells are drilled at increasing, or irregular distances from the original producing area. If a pool extends that far, production is obtained; if it does not extend that far, a "dry hole" results, unless a new pool is entered.

Similarity of the Pools. The pools of Sullivan County are similar in several respects: (1) The oil is of similar quality, a good, light oil, for the most part (that in the Bragdon pool is the heaviest; that in the Shelburn or Heim pool, the lightest. All the oil is pumped together to the refinery. The Refinery for Illinois Pipe Line Company is at Marshall, Ill.) (2) The oil all comes from "oil sands." (3) The depth to corresponding rock formations is approximately the same in all the pools because the surface slopes to the southwest at approximately the same rate that the rock formations dip in that direction. The region has slight relief. (4) In all the pools, all the four oil sands are present. In one of them, all the four sands are productive. Each of the four sands is the chief productive sand in one or more of the pools. (5) The pools are all small, the largest, the Shelburn or Heims has considerable production from only three square miles. The smallest, the Bradgon is only 40 acres. (6) The production per well averaged approximately the same in each pool when it was opened up. (7) The decline per well in yield has been at a somewhat similar rate in each of the pools. (8) Most of the producing wells yield a little gas, more when new than later, however. (Five strong gas wells have been struck in the county, but none in a pool. Four are just southeast of the Scott pool, near Sullivan. Their gas is piped to the city.) (9) In none of the pools is the main gas supply associated with the oil sands.

Production, etc., of the Sullivan County Oil Pools.

Name	No. of Producing Wells	Daily Production in Bbls.	When opened	Average Elevation of Surface, Above Sea Level	Average Depth to Sand	Productive Sand	Depth of Sand Below Sea Level
Heimes or Shelburn........	260	231	1913	520	615–645	1, 2, 3 and 4	100–130
Dodds' Bridge.............	72	51	1915	580	635–683	1 and 2	130–185
Denny.....................	14	14	1914–18	520	800–810	4	180–280
Harmon or Raley..........	19	10	1914–15	480	770–780	3 and 4	290–300
Bradgen..................	6	3	1917	460	–	4	....
Edwards or Buff...........	32	44	1911	480	740–760	2 and 3	260–280
Scott or Jamison..........	79	27	1913–13	530	730–775	2	200–250

Geology of the Pools. Production is obtained in Sullivan County from four oil sands. The highest of these is quite certainly along the unconformity between the Allegheny and the Pottsville Divisions of the Coal Measures. It occurs below Coal 111 and in most places above the level of the lower Minshall coal. As is to be expected on an erosion surface, this sand is higher at some points than at others. It is about 90 feet below Coal 111 in many places, elsewhere it is only 40 feet. In some places it is found below the level at which the upper Minshall coal occurs in not distant wells. In none of the logs however was it found actually below that coal though in some composite logs it is necessarily so shown. Erosion removed both the upper and lower Minshall coals at some points. The sand deposited along such an erosion valley might be below the level of these coals where they occur in intervalley areas. The existence of such valleys is indicated by a number of the well records.

The second and third oil sands are a short distance below the lower block coal and are thus in the Mansfield sandstone of the Pottsville Division of the Pennsylvanian Formation ("The Coal Measures"). The lowest, fourth, oil sand is probably also in the Mansfield, but it may be barely possible that it is in the uppermost Mississippian Formation, the Chester.

The correlation of the coals upon which the above conclusions, as to the ages of the oil sands depends in part was by means of (1) Ashley's identifications of the higher coals in the mines just east of the pools, at Shelburn, Sullivan, Farmersburg and Curry; (2) Upon the spacings of the coals and their thickness as compared with the conditions stated by Ashley in the 1898 and 1908 reports of the State Geologist ,to be characteristic of these horizons where they are penetrated by many mines in the eastern half of this county. (3) A few logs are sufficiently detailed so far as the rocks overlying and underlying the coals are concerned so that some of the coals may be identified by characteristic roof or floor rock. (4) Coal IV contains more gas in this area than does the other coals. In some of the logs mention is made of this gas at this horizon and hence has aided in the correlation. It is of course recognized that there may be mistakes in the numbering of the coals in the following logs. The determination of the age of the oil sands does not, however, depend solely upon the correlation of the coals. The clear evidence of the erosion surface occupied by the first, (Heims or Shelburn pool) oil sand is independent of the correlation of the coals. The existence of three coals

below this oil sand proves that it is not Mansfield in age, as it has been considered. The fact that no coal has been found below the lower oil sands in the several wells which have gone deeper proves that these sands are below the Block coals. The fact that the second and third sands are within a hundred feet or so of the lowest coals proves that they are Pennsylvanian in age, rather than older.

The existence of more than two productive sands has not previously been clearly recognized in this oil field. Many operators have assumed indeed, that there is only one, in spite of indisputable evidence to the contrary long available. Some few operators recognized that two sands are producive, and one operator suspected that three are. A study of the more than 100 well records upon which this study is largely based, shows that a failure to appreciate that more than one oil sand is productive, has reduced production greatly. Many well records show that drilling was terminated only a few feet above the horizon where, in not distant wells valuable production was obtained. In not a few cases, a small amount of oil was found in one of the higher sands. After pumping the oil out of this sand, the well should have been deepened to the next sand, instead of being abandoned, as it has been in nearly every case. Of the four sands which yield oil in paying quantities in one or more wells in this field, the top sand is productive in at least two pools. It is entered at from 610 to 660 feet depending upon the topography of the surface and the location of the well. Most of the production in the chief pool, the Heims or Shelburn is from this level. Much of the production from the Dodds' Bridge pool is also from this level. The second sand is productive in at least three pools. It yields most of the oil in the Scott and the Edwards pools and much of that in the Dodds' Bridge pool. The third sand is productive in at least four pools, the Edwards, Harmon, Scott and Heims. The fourth sand is productive in at least four of the pools, the Bragdon, Harmon, Denny and Heims. The second sand occurs at approximately 660 to 700 feet varying with the pools and the surface. The third sand is at about 730 to 775 and the fourth sand at 800 feet or so. The depth to the sands is less in the Heims pool than in the pools to the west or south because the rock formations dip southwest at a little greater angle than the surface slopes in that direction.

None of the oil sands are uniformly productive. Even only a few hundred feet from a productive well, the corresponding sand in another well may yield no oil. Commonly such a non-productive condition is due to the sand not being porous. That is, it is clayey. In other cases the sand is so thin as to yield little oil. In still other cases it is filled with water. Some of the water is salty. Before abandoning a well, where the sand is filled with water it might pay to pump the water a while. Sometimes oil is obtained after the water has been removed.

The productive sand is from 20 to 30 feet thick in most of the producing wells. Considerable production is obtained in some wells, however, from sands less than 10 feet thick.

The variation in the thickness of the sand in nearby wells, and its presence at some points and absence nearby indicates that the sand

deposits are lenticular or along channels. There commonly is a conspicuous thinning of the sand outward from the center of the pool. In most dry holes, no oil sand, or sand of any kind at that horizon is penetrated. This thinning is not only at the edge. Many dry holes have been drilled within pools. In most of them the sand is so impure as not to be porous, however. In some, it is lacking.

The pools are not known to be related to any local folding or doming. Much oil elsewhere has been proven to have accumulated in paying quantities along the buried sandy channels of ancient streams. The evidence at hand does not warrant a dogmatic statement in regard to the reasons for the pools of Sullivan County being where they are. The indications are, however, that the several pools represent lenses of sand along the valley of an aggrading stream or streams.

The fact, established by a number of well logs, that the depth to the sand is often less near the central part of the pool than near its periphery probably is to be explained by the lenticular shape of the deposits of sand rather than as being due to doming. The depths to the overlying coals do not clearly indicate dynamic doming. The fact that some coals are higher at one point than nearby often show that the coals themselves were not laid down horizontally, because often one coal in a well will be higher than normal and another will be lower, deeper, than normal.

Glacial drift of considerable thickness overlies most of the area. In some wells it is penetrated for nearly 100 feet, in others it is very thin. It has been removed by erosion along some of the valleys in some of the pools. In Dodds' Bridge pool and in Scott pool for example, a seam of coal is exposed in the valley side only a few rods from some oil wells and only a few feet lower.

Special Problems:

1. The present cost of a completed well is about $2,200. When most of the wells were drilled, the average cost was between $1,600 and $1,700. At the present price of oil, a well yielding less than ½ barrel a day will ordinarily not pay for itself, even if located most favorably, in respect to other wells. Rather than abandon such a well, however, it pays to pump it if it can be connected up to a nearby pump. It will bring good interest on the casing and pay the cost of pumping, but not the cost of drilling.

2. Salt water occurs just beneath the lowest oil sand at many points. If the well is drilled too deep, salt water may enter, making the well valueless, in many cases. Many of the dry holes near the pools and elsewhere stop in a salt sand, because of the conviction that when that sand is struck, there is no further hope for oil. This belief is supported by experience, as many wells have gone deeper. However salt water occurs in some wells at levels far above the lowest oil sand. Thence the striking of salt sand is a proper occasion for the abandonment of the hole only when it is struck at about 800 feet.

3. Where the numerous coal seams are penetrated, the casing is etched, probably by sulphuric acid developed from the sulphur in the coal. The pipe becomes bright within a few weeks. Many wells have to be recased or abandoned after only a few months. (If the well does not yield more than ½ barrel, it is not recased.)

Conclusions:

Sullivan County has several pools now yielding oil. The oil comes from four oil sands in the lower Coal Measures partly just above the Pottsville, and partly from the Mansfield horizon of the Pottsville. Undoubtedly other pools will be discovered for in the past the existence of the four oil sands has not been clearly recognized. Many wells have been abandoned before the underlying sands have been tested. The deepest oil sand is only about 800 feet beneath the surface[1].

Composite log for Heims Pool. Based on 50 logs to first oil sand. Average elevation of surface about 523 feet. Surface relief in area about 20 feet:

Coal 8, (average thickness 3 ft.) top at	60 to	70	feet.
Coal 7, (4 ft.)	110 "	150	"
Coal 6a (5 ft.)	170 "	180	"
Coal 6 (6 ft.)	220 "	240	"
Coal 5a (3 ft.)	260 "	280	"
Coal 5 (5 ft.)	305 "	320	"
Coal 4a (rare) 5 ft	340 "	......	"
Coal 4 (5 ft.)	425 "	440	"
Coal 3a (5 ft.)	480 "	500	"
Coal 3 (4 ft.)	520 "	560	"
Gas pockets present in coals 3 and 4.			
1st (main) oil sand	615 "	645	"
Coal 2 (locally) (2 ft.)	608 "	......	
Minshall (4 ft.)	636 "	640	"
Upper block?	655 "	661	"
2nd oil sand	660 "	680	"
Lower block coal?	690 "	694	"
3rd oil sand	705 "	708	"
Salt sand or oil sand (Osborn pool)	775 "	815	"

Composite log for Section 35, Fairbanks Township in N. W. part Heims' Pool. Based on 4 logs for coals and on 6 for oil. Elevation of surface about 500 feet:

Coal 8, top at	to	70	feet.
Coal 6a	170 "	175	"
Coal 6	220 "	225	"
Coal 4	435+	......	
Coal 3a	492 to	......	"
Coal 3	550 "	......	
Best oil (2 wells)	615 "	620	"
Best oil (2 wells)	645 "	......	
Best oil (2 wells)	658 "	669	"

[1]The author received much information from L. H. Crews, Shelburn, the local manager of the Ohio Oil Co., the dominant company in this area, and from John Kerens, Sullivan, the local gager for the Illinois Pipe Line Co. Some of the logs studied are given in the 38th (1913) Report of the State Geologist.

Composite log from Section 36, Fairbanks Township, in north central part of Heims' Pool. Based on 5 logs for coals and on 16 logs for sand. Elevation of surface about 520 feet:

Coal 6a top at	175 to	205 feet.
Coal 6 top at	215 "	226 "
Coal 5 top at	310 "	320 "
Coal 4 top at	425 "	450 "
Coal 3a top at	485 "	495 "
Coal 3 top at	540 "	560 "
Best oil (7 wells)	615 "	620 "
Best oil (4 wells)	661 "	681 "
Best oil (1 well)	709 "	......

Composite log, Section 1, Turman Township, in central part of Heims' Pool. Based on 11 logs for coals and 18 logs for sand. Elevation of surface about 530 feet:

Coal 8 top at	...... to	60 feet.
Coal 7 top at	110 "	150 "
Coal 6a top at	150 "	205 "
Coal 6 top at	225 "	......
Coal 5a top at	260 "	280 "
Coal 5 top at	305 "	315 "
Coal 4 top at	445 "	470 "
Coal 3a top at	480 "	......
Coal 3 top at	510 "	565 "
Best oil (13 wells)	622 "	645 "
Best oil (4 wells)	666 "	675 "

Some gas found in coal 3 and above it and in coal 4.

Log for N. ½, N. W. ¼, N. E. ¼, Section 12, Turman Township, south edge of Heims' Pool. Elevation about 525 feet:

Coal 6a	173 to	178 feet.
Coal 6	238 "	240 "
Coal 4a	340 "	345 "
Coal 4	470 "	474 "
Sand (oil)	640 "	655 "

Went to 685 but found no more sand.

Log of well 1 mile west of Heims' Pool, in Section 3, Turman Township (T. 8 N., R. 10 W.) High ground about 500 feet:

Coal 6	200 to	207 feet.
Coal 5a	250 "	253 "
Coal 3a	490 "	495 "
Oil sand	619 "	634 "
Upper block coal or Minshall	655 "	......

Log of Emery Smith well No. 2, S. E. ¼, Section 4, T. 8 N., R. 9 W., southwest of Shelburn, about 2 miles east of Heims' Pool. Elevation of top of well, 540 feet:

Gravel and quick sand	to	43 feet.
Hard lime shell	"	49 "
Gray sandstone	"	90 "

Gray shale	to	120	feet
White slate	"	130	"
Gray shale	"	165	"
Light sand	"	175	"
Black slate	"	179	"
Coal 6a	"	184	"
Fire clay	"	202	"
Brown shale	"	225	"
Sandstone	"	230	"
Brown slate	"	239	"
Hard lime shell	"	244	"
White slate	"	250	"
Sandy shale	"	265	"
Gray shale	"	310	"
White slate	"	335	"
Coal 5	"	350	"
Black slate	"	355	"
White slate	"	365	"
Brown slate	"	380	"
Black slate	"	400	"
Coal 4a	"	405	"
Brown slate	"	420	"
Sandstone	"	433	"
Coal 4	"	440	"
Gray shale	"	445	"
Brown shale	"	455	"
Lime shell	"	460	"
Sandy slate	"	465	"
Brown shale	"	475	"
Coal 3a and black slate	"	485	"
Gray shale	"	495	"
White slate	"	546	"
Brown slate	"	551	"
Coal 3	"	556	"
Brown shale	"	580	"
Lime shell	"	583	"
Light slate	"	600	"
White chocolate sand	"	615	"
Black slate	"	622	"
Dark hard oil sand	"	633	"
Black slate	"	643	"
Total depth	"	643	"

Well abandoned July 5, 1919.

Record of Wm. Scott well No. 1, N. W. ¼ of S. E. ¼ of Section 33, Township 9 N., R. 9 W., 2 miles east of Heims' Pool. Elevation of surface about 540 feet:

Gravel and sand	to	28	feet.
Pink rock	"	30	"
Gray sandstone	"	45	"

Gray slate	to	70	feet
Black slate	"	95	"
Fire clay	"	105	"
Sandy shale	"	140	"
Sandy shale	"	172	"
Coal 6a	"	176	"
Fire clay	"	186	"
Gray sandstone	"	206	"
Black slate	"	216	"
Coal 6	"	222	"
Fire clay	"	226	"
Dark slate	"	240	"
Black slate	"	260	"
Gray shale	"	270	"
Hard lime shell	"	275	"
Coal 5a	"	277	"
Black slate	"	320	"
Light slate	"	360	"
Black slate	"	380	"
Coal 4a	"	384	"
Brown shale	"	440	"
Light slate	"	460	"
Coal 4	"	466	"
Brown shale	"	490	"
Black slate	"	505	"
Sandy shale	"	545	"
Gray shale	"	570	"
Black slate	"	600	"
Light slate	"	620	"
Gray shale	"	635	"
Hard dark sand lime	"	665	"
Light slate	"	675	"
Gray slate	"	690	"
Black slate	"	700	"
Light brown sand	"	710	"
Dark sandy shale	"	728	"
Salt, sand and water	"	730	"
Total depth	"	730	"

Well abandoned.

Record of Smith well No. 1, located in the S. E. ¼ of the N. E. ¼ of Section 4, Township 8 N., Range 9 W., Curry Township, 5 miles north of Heims' Pool, 2 miles west of Farmersburg. Elevation above sea level at top of well about 530 feet:

Drift	to	44	feet.
Soft sand	"	50	"
Hard shell	"	55	"
Red rock	"	65	"
Slate	"	85	"
Sandstone and water	"	90	"

Gray slate	to	130	feet
Brown slate	"	141	"
Coal No. 7	"	146	"
Black slate	"	160	"
Sandstone	"	170	"
Brown slate	"	180	"
Coal 6a	"	186	"
White slate	"	195	"
White slate	"	205	"
Black slate, some gas	"	210	"
White slate	"	230	"
Sandstone	"	247	"
Hard shell	"	250	"
Hard lime shell	"	257	"
Black slate	"	261	"
Coal 6	"	266	"
White slate	"	290	"
Brown slate	"	352	"
Coal 5	"	358	"
Black slate	"	404	"
Coal 4a	"	408	"
Light slate	"	415	"
Sand and water	"	430	"
Water and sand	"	435	"
Black slate	"	443	"
Coal 4	"	450	"
Brown slate	"	460	"
White slate	"	470	"
Gray slate	"	484	"
Hard shell	"	486	"
Coal 3a	"	488	"
Black slate	"	500	"
White slate	"	520	"
White sand	"	535	"
Brown slate	"	560	"
Coal 3	"	565	"
Brown slate	"	575	"
Brown slate	"	580	"
Black slate or shale	"	589	"
Gray shale	"	595	"
Gray shale and coal	"	602	"
Lime shell	"	608	"
Gray shale and lime	"	614	"
Gray shale and lime	"	620	"
Gray slate	"	626	"
Gray sandy shale	"	630	"
Oil sand, no production	"	635	"

Composite log for Dodds' Bridge Pool. Based on 8 logs in Sections 3, 4 and 9, Turman Township. Elevation about 500 feet. Relief about 30 feet:

Coal 6a top at	170	to	183	feet.
Coal 6	......	“	200	“
Coal 5a	250	“	260	“
Coal 5	305	“	320	“
Coal 3a	460	“	490	“
Coal 3	......	“	550	“
Oil sand (slight production)	......	“	619	“
Coal Minshall (where present)	620	“	636	“
Main oil sand (Minshall absent)	634	“	656	“
Upper block	643	“	660	“
Oil sand	656	“	683	“
Lower block	......	“	690	“
3rd oil sand	......	“	730	“

Composite log for Harmon pool, Sections 28 and 33, Turman Township. Based on 6 logs. Elevation of surface about 480.

Coal 8 (average 5 feet) top at			85	feet.
Coal 7 (3 feet) top at			160	“
Coal 6 (5 feet) top at			270	“
Coal 5a (4 feet) top at			330	“
Coal 5 (5 feet) 3 wells			360	“
Coal 4a (4 feet)	380	to	385	“
Coal 4 (5 feet)			440	“
Coal 3a (5 feet)			580	“
Coal 3 (5 feet) 2 wells			600	“
Slate sand (first oil sand)			620	“
Minshall coal, 6 feet	629	“	642	“
2nd oil sand (95 barrel well)			740	“
Main oil sand	767	“	780	“
4th oil sand (75 barrel well)			818	“

Composite log for Scott pool, based on 10 logs in Sections 31 and 36, Turman Township. Average elevation of surface about 530. Relief in pool about 20 feet.

Coal 8 top at	80	to	90	feet.
Coal 7 (5 feet) top at	95	“	115	“
Coal 6a (4 feet) top at	170	“	172	“
Coal 6 (5 feet) top at	255	“	290	“
Coal 5 (6 feet) top at	320	“	348	“
Coal 4 (5 feet) top at	440	“	......	“
Coal 3 (5 feet) top at	560	“	585	“
Upper Block (4 feet)			680	“
Lower Block (3 feet)			700	“
Oil sand, top of	730	“	775	“

Composite log for Edwards pool and vicinity, in Sections 3, 9, 10 and 16. Gill Township. Based on 7 fairly detailed logs. Elevation of surface about 480 feet.

Coal 8 (3 feet) top at	80	to	90	feet.
Coal 7 (2 feet) top at	107	“	110	“

Coal 6a (5 feet) top at	210 if present.	
Coal 6 (4 feet) top at	230 to 245	feet.
Coal 5a (5 feet) top at	285 if present.	
Coal 5 (4 feet) top at	330 to 340	feet.
Gas sand, top at	375 " 385	"
Coal 4a (1 foot)	421	"
Gas sand (coal 4 level)	460	"
Coal 2 (5 feet)	585	"
Coal 2 ? (5 feet) where present	605	"
Heims' pool oil sand top at	630 to 640	feet.
Minshall (5 feet)	660 " 685	"
Upper Block (5 feet)	715	"
Scott pool oil sand	740 " 756	"
3rd oil sand	770 " 785	"
4th oil sand	820 " 822	"
Salt sand	884 " 900	"

Log of wells 9 and 10, G. W. Buff farm, N. W. ¼, S. W. ¼, Section 3, Gill Township, near N. E. Corner of Edwards pool.

Clay and shale	...... to 80	feet.
Coal 8	80 " 82	"
Shale	82 " 240	"
Hard shell	240 " 245	"
Coal 6	245 " 251	"
Shale	251 " 330	"
Coal 5 with some gas	330 " 336	"
Shale	336 " 400	"
Limestone	400 " 408	"
Shale and mud	408 " 500	"
Sand with water	500 " 522	"
Shale and mud	522 " 640	"
First salt sand, some oil	640 " 675	"
Limestone	675 " 685	"
Coal, Minshall	685 " 690	"
Dark shale	690 " 715	"
Coal, upper block	715 " 720	"
Dark shale	720 " 756	"
3rd oil sand	756 " 770	"
Dark shale	770 " 785	"
4th lower oil sand	785 " 805	"
Dark shale	805 " 817	"

Note: Well No. 9 got 10 barrels production at 756 sand. Well No. 10 found merely a show of oil there, but got production at 785. Well No. 10 is 444 feet east of well No. 9.

Township 8 North, Range 10 West.

Chastine No. 2

10 inch drive pipe	61	feet.
Salt sand	300 to 350	"
Coal	465 " 470	"

8 inch casing	550 feet
Salt sand	560 " 600 "
6¼ inch casing	750 "
Oil sand	786 "
Total depth	800 "

Bell No. 4

10-inch pipe	42 feet.
Coal	446 to 450 "
8 inch casing	350 "
6¼ inch casing	629 "
Oil sand	786 "
Total depth	797 "

McClure No. 4

10 inch drive pipe	32 feet.
Coal	465 to 471 "
8 inch casing	540 "
Salt sand	560 " 740 "
6¼ inch casing	775 "
Oil sand	796 "
Total depth	806 "

Well No. 2 on Oscar Hunt farm, Sullivan County:

From top of surface, red clay	to 42 feet.
Dark mud	80 "
Coal	84 "
Mud and shale	120 "
Sand and some water	180 "
Hard limestone shell	190 "
Dark mud	220 "
Sandy and hard material	260 "
Coal	265 "
White and black mud	340 "
Coal	345 "
White mud	350 "
Hard shell	355 "
Dark and white mud	465 "
Limestone shell—hard	475 "
White and dark mud	525 "
Coal	530 "
Dark shale	560 "
Sand with some water and nice showing of oil	600 "
Coal with plenty of water	605 "
Dark shale	625 "
Sand—hard	635 "
Dark shale	685 "
Coal and gas water flowing out of hole	690 "
Dark shale	730 "
Top of oil sand	752 "

Broken sand and shale	775 feet	
Oil sand	780 "	
Dark shale	800 "	
Total depth of well	800 feet.	
10 in. pipe	42 feet.	
8¼ in. pipe	355 "	
6¼ in. pipe	721 "	

SWITZERLAND COUNTY

The following strata outcrop in Switzerland County:

Quaternary	Recent—Alluvial sands and clays. Pleistocene—Glacial gravel, sand and till.
Silurian	Limestones and shales.
Ordovician	Shales and limestones.

The glacial deposits vary in thickness from a few feet to fifty. Many outcrops of the bed rock occur. It is possible that the structural conditions may be determined by surficial observations. The outcrop of the Trenton in the eastern part of the county precludes the possibility of securing oil from that formation in that locality but in the western part of the county where the thickness of the overlying formations is adequate, oil may be present in the Trenton if the proper structural conditions exist.

The following is the record of a well drilled at Vevay:

Record of Well Drilled Near Vevay.

Surface, soil and clay	60	feet.
Limestone shell and shale, 6 inches thick alternating	105	"
Limestone	75	"
Layers of shale and limestone 5 feet thick alternating	60	"
Dark hard limestone	22	"
Shale, soft	1	"
Limestone, very hard and full of salt water	32	"
Total depth	355	feet.

TIPPECANOE COUNTY

Beneath the Pleistocene and Recent deposits of this county lie the strata of the New Albany division of the Devonian which occupies the northeast portion of the county and the Knobstone division of the Mississippian. The contact between the two formations is revealed between the Wabash River and West Lafayette by an outcrop of Goniatite limestone which lies at the base of the Knobstone just above the unconformity between the Devonian and the Mississippian. Small outcrops of the Warsaw occur near Montmorenci, but the number is too small to be of much service in determining structural conditions. The Pleistocene deposits vary in thickness from a few feet to more than one hundred feet. The

mantle of glacial drift is everywhere so complete that little can be learned of stratigraphical or structural features of the bed rock. If oil structures are present in the county, they can be outlined only by the use of subsurface data derived from the records of deep wells, and to be of value the wells should be located within less than a mile of each other as the structures will probably be small.

A well drilled at Lafayette reached the top of the Niagara limestone at 235 feet. The top of the Trenton should be reached at about 1100 feet.

Railroad Elevations.

Clark's Hill 818.6; Stockwell 810; Crane 736; Altamount 645; Lafayette 542 (Monon Sta.); Dayton 647.1; Summit 608; Balls 697; Montmorenci 692.

TIPTON COUNTY

Tipton County lies within the glaciated area and is covered with glacial drift varying in thickness from 50 to 150 feet. The drift rests on the Silurian and Devonian limestones. The surface of the Trenton lies from about sea level to 150 feet below.

Cicero Township. Three wells were drilled at Tipton, and the record of No. 1 is given below:

Drift	139	feet.
Limestone	326	"
Shale	532	"
Trenton limestone, gas 11 ft., oil 3 ft., water 19 ft.	33	"
Total	1030	feet.
Altitude of well	868	"

Well on the R. H. Foster farm, N. E. corner of the S. ½ of S. ½ of N. W. ¼ of Section 30, Twp. 22, R. 4 E. Cicero Twp.

Top of sand	1002	feet.
Drilled in sand	14	"
Total depth	1016	"
Casing used	503	"
Drive pipe	147	"

Dry hole.

Wells drilled in Sections 20 and 28 were abandoned in 1911.

Madison Township. At Hobbs gas was obtained and the first well has the following log:

Drift	134	feet.
Limestone	330	"
Shale and limestone	529½	"
Trenton limestone	13½	"
Total depth	1007	feet.
Altitude of well	875	"

A well drilled in Section 19 was abandoned in 1911.

Wild Cat Township. At Windfall the Trenton was reached at 937 feet and salt water at 1002 feet. Wells drilled in Sections 8, 17, 18, 20, and 31 were abandoned in 1911 and 1919.

Liberty Township. At Sharpsville gas was obtained from wells in which the following strata were encountered:

Drift	70	feet.
Limestone	460	"
Shale	432	"
Trenton limestone	8	"
Total	970	feet.

Well drilled N. of the S. W. corner of Section 19, T. 22 N. R. 4. E., on the S. J. Smith farm:

Top of sand	1008	feet.
Depth drilled in sand	18	"
Total depth of well	1026	"
Dry hole.		

Abandoned wells occur in this township as follows: Section 1, 1 well; Section 5, 2 wells; Section 13, 1 well; Section 18, 2 wells; Section 22, 1 well; Section 23, 1 well; Section 31, 1 well; Section 35, 1 well; Section 36, 1 well.

Jefferson Township. At Kempton the upper surface of the Trenton is 93 feet below sea level. The log of the Kempton well follows:

Drift	306	feet.
Limestone	293	"
Shale	424	"
Trenton limestone	12	"
Total depth	1035	feet.
Altitude of well	930	"

A well drilled in Section 9 was abandoned in 1913 and one in Section 20 in 1912.

Prairie Township. Wells have been abandoned in this township as follows: Section 2, 2 wells; Section 10, 1 well; Section 15, 1 well; Section 16, 1 well; Section 22, 1 well; Section 23, 1 well; Section 24, 2 wells; Section 26, 1 well; Section 28, 1 well; Section 32, 1 well; Section 33, 1 well; Section 34, 3 wells.

UNION COUNTY

Strata of Ordovician and Silurian age form the bedrock of this county. The Silurian rocks have been removed from all except the northeastern part of the county. The thickness of the Ordovician rocks is about 800 feet. The overlying drift has a thickness of from twenty-five to seventy-five feet. Since the drift is not as thick as in other counties and outcrops of the bed rock are more numerous it may be possible by detailed work to determine the structural conditions in this county.

The record of a well drilled at Liberty is given by Phinney as follows:

Drift	70	feet.
Limestone (Hudson River)	15	"
Grayish shale	450	"
Dark shale	356	"
Gray Trenton limestone	25	"
Blue Trenton limestone	55	"
Total depth	971	feet.
Altitude of well	965	"

Gas was reported in small quantities from the Hudson River shale but none in the Trenton.

The surface of the Trenton is probably more than 100 feet above sea level in the southwestern part of the county and descends to sea level in the northeastern part.

Railroad Elevations.

Cottage Grove 1,039, Kitchell 1,096, Wilts 1,119, Loties 1,039, Liberty 980, Brownsville 793.

VANDERBURGH COUNTY

Vanderburgh County lies within the unglaciated area of the State. The strata which outcrop in the county belong to the Pennsylvanian period. The rocks consist of sandstones, shales, and limestones with intercalated beds of coal. The southern part of the county is occupied by the alluvium of the Ohio River valley and outcrops of the bed rock are not found. It is doubtful whether a sufficient number of outcrops of persistent layers can be found to determine structural conditions. It may be possible to use well records, mine shaft records, and outcrops and thus determine the structural conditions of the strata. Care should be exercised in using the dip of the rocks of the coal measures to discriminate between purely local dips which are so abundant, and dips of regional extent.

The following is the record of a well drilled on the east bank of Pidgeon Creek near Evansville:

Section in Crescent City Artesian Well.

Soapstone	31	feet.	
Gray sandstone	2	"	6 in.
Soapstone and shale	37	"	6 "
Very hard gray sandstone	1	"	
Slaty coal	1	"	6 "
Shale	6	"	
Gray shale or sandstone	44	"	6 "
Soft shale	11	"	
Soft gray sandstone	18	"	
Hard dark sandstone	5	"	
Gray flint	2	"	
Dark gray sandstone	62	"	
Salt water			

Hard black shale (coal?)	73 feet.	
Gray sandstone	65 "	
Flint	6 "	
Hard gray shale	5 "	
Hard argillacious sandstone	34 "	
Gray shales (soapstone)	55 "	
Coal (L?)	1 "	6 in.
Gray shale and sandstone	134 "	
Dark sandstone with salt water flowing seven gallons per minute, 3 degrees Baume	5 "	
Hard pure sandstone, conglomerate	50 "	
Coal and slate		6 "
Soapstone	10 "	
Coal (A?) and slate	1 "	6 "
Fire clay		6 "
	682 feet.	
Surface	17 "	
Total	709 feet.	

Section in Avondale Bore.

Surface	9 feet,	6 in.
Blue clay	30 "	6 "
Gray sand	2 "	6 "
Blue mud, quick sand	22 "	3 "
Gravel, sand and shells	6 "	
Fire clay and sand	28 "	3 "
Gravel and sand	1 "	
Sandstone	2 "	
Fire clay	2 "	9 "
Sandstone	11 "	
Fire clay	7 "	9 "
Sandstone	7 "	
Fire clay with pebbles	2 "	8 "
Silicious clay	1 "	
Sandstone with iron balls	72 "	
Concretion	1 "	10 "
Sandstone	36 "	10 "
Rock slate	6 "	
Black slate	2 "	10 "
Coal	4 "	
Total	256 feet,	9 in.

Section of Inglefield Bore.

Surface clay	10 feet.	
Red Merom sandstone	36 "	
Carbonaceous parting, coal		4 in.
Hard flinty limestone	4 "	
Clay parting, second rash coal	1 "	8 "

Flinty gray limestone	6 feet.	in.
Light gray sandstone	20 "	
Soft white limestone	8 "	
Soapstone, first rash coal	16 "	3 "
Shale	20 "	
Gray flinty limestone	3 "	2 "
Soapstone	26 "	
White limestone	30 "	
Gray shale	20 "	
Fire clay	10 "	
Coal (N?)	1 "	6 "
Fire clay	4 "	
Gray shale	10 "	
Soap stone	28 "	
Sandstone	3 "	
Black slate	2 "	
Sandstone	17 "	
Total	276 feet, 5 in.	

Scott Township. A well was drilled on the John M. Hart farm in 1913; it resulted in no production. A well drilled on the R. Cutter farm in 1918 was non-productive. Records of the wells could not be obtained.

VERMILLION COUNTY

Vermillion County lies wholly within the area occupied by the Penn sylvanian strata, the outcrop of which is covered by the Pleistocene and Recent deposits. These deposits of mantle rock attain a thickness of more than one hundred feet. This regolith has been largely removed along the courses of the streams and outcrops of the durolith occur. It may be possible, that by using these outcrops in connection with coal openings and the records of wells, to determine the structural conditions of the bed rock, though careful work will be necessary and much time required.

The surface of the Trenton is probably 1600 or more feet below the level of the sea. If structures are present oil may be found in Trenton, Devonian or Pennsylvanian strata.

Railroad Elevations.

Cayuga 522; State Line (T., St. L. & W.) 626; Rileysburg 646; Gessie 616; Perrysville 582; Dickason 526; Malone 507; Walnut Grove 528; Newport 496; Dorner 510; Worthy 489; Mt. Silica 492; West Montezuma 488; Hillsdale 488; Logan 496; Summit Grove 520; Norton Crossing 493; Jackson 495; Clinton 494.

VIGO COUNTY

Strata belonging to the Pennsylvanian period occupy the sub-surface in Vigo County. The rocks are sandstones, shales, and limestones with intercalated beds of coal. A covering of glacial drift largely conceals the outcrop of the durolith, the thickness of the latter varying from a few feet to more than one hundred feet. The structural conditions of the durolith can probably be determined by using coals IV and V as key horizons and relying on data secured from well records and coal outcrops for the position of these beds.

Harrison Township. Oil has been produced from a single well in Terre Haute for more than thirty years. The following is the record of a well drilled on the bank of the river at Terre Haute in 1869:[1]

Record of Terre Haute Well.

		Feet.	Inches	Feet	Inches
1.	Sand and gravel	100		100	
2.	Soapstone	64	6	164	6
3.	Coal	6	2	170	8
4.	Hard sandstone	2	3	172	11
5.	Soapstone	10		182	11
6.	Coal	3		185	11
7.	Soapstone	4	3	190	2
8.	Gray sandstone	5	10	196	
9.	Blue soapstone		10	196	10
10.	Gray sandstone		6	197	4
11.	Blue soapstone	12	9	210	1
12.	Soft black shale	6		216	1
13.	Coal		9	216	10
14.	Soapstone	7	7	224	5
15.	White sandstone (conglomerate)	30	3	254	8
16.	Blue shale	7	2	261	10
17.	Coal	2	3	264	1
18.	Black shale	10		274	1
19.	White soapstone	3		277	1
20.	Black shale	15		292	1
21.	White soapstone	8		300	1
22.	Black shale	3	3	303	4
23.	Coal	3		306	4
24.	Soapstone	17	8	324	
25.	Sand rock	3		327	
26.	Soapstone	20		347	
27.	Sand rock	10		357	
28.	Blue shale	22		379	
29.	Limestone	2		381	
30.	Blue shale	31		412	
31.	Light shale	5		417	
32.	Blue shale	60		477	
33.	Sandstone	7		484	

[1]Report of Indiana State Geological Survey for 1870.

		Feet.	Inches	Feet	Inches
34.	Blue shale	24		508	
35.	Sandstone	3		511	
36.	White shale	10		521	
37.	Blue shale	147		668	
38.	Hard gritty slate rock	11	7	679	7
39.	Hard gray sandstone	14	5	694	
40.	Hard limestone	11		705	
41.	White limestone	24		729	
42.	Gray limestone	2		731	
43.	Limestone	14		745	
44.	White limestone	82		827	
45.	Soapstone	3		830	
46.	Brown limestone	35		865	
47.	Soapstone	5		870	
48.	Lime rock	9		879	
49.	Soapstone	6		885	
50.	White limestone	7		892	
51.	Soapstone or Gypsum?	2		894	
52.	White limestone	21		915	
53.	Gray limestone	5		920	
54.	Limestone and soapstone	5		925	
55.	Gray limestone	5		930	
56.	White limestone	15		945	
57.	Fine blue limestone	2		947	
58.	Dark gray limestone and flint	73		1020	
59.	Light gray limestone	7		1027	
60.	Blue gray limestone	7		1034	
61.	Soapstone (fire clay)	26		1060	
62.	Gray limestone	24		1084	
63.	Gray sandstone	3		1087	
64.	Soapstone (fire clay)	5		1092	
65.	Quartz and shale mixed	166		1258	
66.	Quartz, slate and soapstone	3		1261	
67.	Slate rock	21		1282	
68.	Soapstone	33		1315	
69.	Slate rock	7		1322	
70.	Soapstone	235		1557	
71.	Soapstone and sandstone	10		1567	
72.	Fine sandstone	15		1582	
73.	Blue soapstone	40		1622	
74.	Black shale	15		1637	
75.	Red shale	5		1642	
76.	Black shale	15		1657	
77.	Lime rock	5		1662	
78.	Black shale	5		1667	
79.	Gray lime rock, oil near top	149		1816	
80.	Gray sand rock	23		1839	
81.	Lime rock	73	4	1912	4

In discussing the geology of Vigo County in the annual report of the Indiana Survey for 1896, Dr. J. T. Scovell publishes the following well records:

Swan Street Well on Banks of Wabash.

Sand, gravel sandstone, shale and limestone	1110 feet.	1110 feet.
Limestone	450 "	1560 "
Shale	50 "	1610 "
Limestone	3 "	1613 "

Oil Sand and Oil.

Limestone	967 feet.	2580 feet.
Shale	100 "	2680 "
Limestone (perhaps Trenton)	250 "	2930 "

Section of Kinser Well.

Located between Fourteenth and Fifteenth streets just east of the center of section 22-12-9 near Liberty avenue.

Soil, gravel and sand	80 feet.	80 feet.
Shale or soapstone	70 "	150 "
Sandstone	10 "	160 "
Shale	90 "	250 "
Sandstone	70 "	320 "
Shale or slate	130 "	450 "
Sandstone	140 "	590 "
Limestone	360 "	950 "
Limestone with some shale	185 "	1135 "
Limestone with quartz	85 "	1220 "
Shale	25 "	1245 "
Limestone with shale	225 "	1470 "
Shale or soapstone	5 "	1475 "
Sandstone or limestone	15 "	1490 "
Shale or soapstone	138 "	1628 "
Limestone or oil rock	20 "	1648 "

A little oil was present near the surface of the limestone. To reduce these records and the following to the level of the river fifty feet was deducted from the thickness of the first stratum.

Section of the Big Four Well.

Located in the northeast corner of the northwest quarter of Section 23-12-9.

Soil	6 feet.	
Gravel	10 "	
Sand	102 "	68 feet.
Shale	117 "	185 "
Sandstone or limestone	2 "	187 "
Shale	207 "	394 "
Salt water at 78 feet below the top of shale.		
Limestone or sandstone	41 "	435 "
Shale or slate	50 "	485 "
Limestone or sandstone	12 "	497 "
Shale or slate	53 "	550 "

Sandstone	50 feet.	600 feet.
Limestone	600 "	1200 "
Shale with some limestone	190 "	1390 "
Shale or slate	210 "	1600 "
Limestone, oil rock sulphur water	18 "	1618 "

Section of Exchange Well.

Situated a little west of the center of Section 22-12-9:

Soil and coarse gravel	80 feet.	30 feet.
Sand fine	45 "	75 "
Shale and slate	65 "	140 "
Coal at 22 feet below the top of shale.		
Limestone	5 "	145 "
Shale	95 "	240 "
Limestone	10 "	250 "
Shale	40 "	290 "
Limestone	20 "	310 "
Shale	210 "	520 "
Limestone	23 "	543 "
Shale	10 "	553 "
Limestone, hard and flinty	82 "	635 "
Shale	5 "	640 "
Limestone	160 "	800 "
Limestone with sand	70 "	870 "
Sandstone	30 "	900 "
Limestone	25 "	925 "
Sandstone	65 "	990 "
Limestone	30 "	1020 "
Shale	180 "	1200 "
Sandstone, white	50 "	1250 "
Sandstone and shale	50 "	1300 "
Sandstone, white	150 "	1450 "
Shale	122 "	1572 "
Limestone—oil rock	11 "	1583 "

Show of oil at 1575 and sulphur at 1578 feet.

Alden Well.

On northwest quarter of Section 23-12-9:

Sand and gravel	130 feet.	80 feet.
Shale	110 "	190 "
Limestone	20 "	210 "
Shale	300 "	510 "
Sandstone	10 "	520 "
Shale	30 "	550 "
Sandstone	160 "	710 "
Limestone	300 "	1010 "
Sandstone	90 "	1100 "
Shale with sand	132 "	1232 "

Salt water at 525 feet and between 600 and 700 feet.

Section of the Elliott Well.

Near west line of Section 23 and Wabash avenue, Terre Haute.

Sand and gravel	128	feet.	78	feet.
Shale	260	“	338	“
Sandstone	35	“	373	“
Limestone	40	“	413	“
Sandstone	98	“	511	“
Limestone	23	“	534	“
Sandstone	179	“	713	“
Shale	110	“	823	“

The Smith well drilled near the southwest corner of Wabash avenue and Tenth street, southwest of the southwest section 22-12-9 reached the oil-bearing limestone at 1632 feet.

The Guarantee No. 3 between Eighth and Ninth streets, near Wabash avenue reached oil rock at 1569 feet.

The Guarantee No. 4 between Wabash avenue and Chestnut street on Tenth-Half street reached sulphur water at 1590 feet.

The Guarantee No. 5 near southwest corner South Fifth and Farrington streets southeast of the northeast section 28-12-9 reached oil sand at 1700 feet.

Section of Guarantee Well No. 6.

Northeast corner Third and Mulberry streets, northwest ¼ of the southeast ¼ section 21-12-9.

Soil, gravel and sand	128	feet.	78	feet.
Shale	44	“	122	“
Coal	5	“	127	“
Shales and sandstone	308	“	435	“
Limestone	40	“	475	“
Shale, blue and black	90	“	565	“
Limestones	415	“	980	“
Limestone, coarse	25	“	1005	“
Shale with some limestone	55	“	1060	“
Shale with some limestone	40	“	1100	“
Limestone with some shale	320	“	1420	“
Shale	25	“	1445	“
Limestone	9	“	1454	“
Shale	43	“	1497	“
Black shale, lime shell	72	“	1569	“
Coarse shale	9	“	1578	“
Limestone, black	20	“	1598	“

Salt water at 800 feet, gas at 925, 160 and 1100 feet, sulphur water at 1598 feet.

Guarantee No. 1 (Diall well) located on the alley between Chestnut and Eagle streets and between Ninth and Tenth was drilled to oil on May 8, 1888. Oil rose fifty feet above the surface, "flowed out over the whole region into the sewer and down to the river and its villainous odor filled the air for squares."

The Phenix well was drilled 300 feet south between Eagle and Mulberry streets and became a good producer.

Guarantee No. 3 near Wabash avenue between Eighth and Ninth streets also produced some oil. The productive area is very small. Wells were drilled in all directions from the productive wells but yielded water only.

Riley Township. The Riley oil field is located southeast of the town of Riley in section 23 and 24. Oil has been produced from about twenty-five wells. The largest initial production is about twenty-five barrels per day. The locations of the producing wells on the accompanying map were made by Dr. C. A. Malott.

Joslin Well Record.

A well was completed October 7, 1912 on the Charles N. Joslin farm, Section 23, Township 11, North, Range 8 West, Riley Township, Vigo County, Indiana, by Bill Brothers. The following is a complete log of the well:

Clay	12	feet.
Sand rock to 21 feet	9	"
Lime to 40 feet	19	"
Slate to 76 feet	36	"
10" pipe	76	"
Lime to 85 feet	9	"
Brown shale to 120 feet	35	"
Sand rock to 180 feet	60	"
Coal to 182 feet	2	"
Brown shale to 196 feet	14	"
Lime to 210 feet	14	"
Slate to 240 feet	30	"
Lime to 248 feet	8	"
Slate to 275 feet	27	"
White sand (water) to 290 feet	15	"
Slate to 340 feet	50	"
Lime to 355 feet	15	"
Slate to 390 feet	35	"
Salt sand (more water) to 420 feet	30	"
Slate to 450 feet	30	"
Lime to 465 feet	15	"
Slate to 490 feet	25	"
White sand to 560 feet	70	"
Slate to 620 feet	80	"
Lime to 625 feet	5	"
Salt sand to 645 feet	20	"
Lime to 660 feet	15	"
Hard lime to 710 feet	50	"
8¼" casing	663	"
White lime with small break 750 feet	40	"
Hard lime to 820 feet	70	"
White lime to 990 feet	170	"
Slate and shells to 1060 feet	70	"
Slate to 1100 feet	40	"
Lime to 1115 feet	15	"
Slate to 1160 feet	45	"

Lime to 1170 feet	10 feet.
Slate to 1220 feet	50 "
Lime to 1230 feet	10 "
Slate to 1250 feet	20 "
Black slate to 1290 feet	40 "
Lime to 1310 feet	20 "
Slate to 1370 feet	60 "
Lime to 1380 feet	10 "
Slate to 1440 feet	60 "
Lime to 1445 feet	5 "
Slate to 1455 feet	10 "
Lime shell to 1458 feet	3 "
Slate to 1507 feet	49 "
6⅝" casing	1507 "
Lime to 1520 feet	13 "
Slate and shells to 1555 feet	35 "
Brown shale to 1615 feet	60 "
Lime to 1617 feet	2 "
Slate to 1619 feet	2 "
Sand or cap rock to 1621 feet	2 "
First oil to 1623 feet	2 "
Light brown shale to 1625 feet	2 "
Dark brown sand to 1629 feet	4 "
Light and lime sand to 1631	2 "
Gray shelly sand to 1637 feet	6 "
Light shelly sand to 1641 feet	4 "

Oil only in one place 1621 to 1625.

Linton Township. A deep well was drilled in this township just west of Pimento in section 14. No production was obtained. A well was also drilled in section 1 of this township without favorable results. Many wells in this township have been drilled to coal V, which is penetrated at depths ranging from 320 feet to 500 feet.

Sugar Creek Township. The record of a well drilled at St. Mary's-in-the-Wood on the northeastern quarter, southwestern quarter, Section 6-12-9 is given by Scovell as follows:

	Feet	Total Feet
Surface soil and yellow clay	20	
Blue clay	55	
Blue clay and quicksand	25	Low water
White shale	25	25
Coal, probably coal "N"	5	30
White shale—fire clay and shale	65	95
Coal, probably coal "M"	6	101
White shale—fire clay and shale	90	191
Coal, probably "L", the big vein	10	201
Fire clay and white shale	50	251
White sand rock	40	291

	Feet	Total Feet
White shale	229	520
Sandstone	80	600
Limestone	490	1090
Fresh water at 730 feet.		
Shale	50	1140
Brown sandstone	20	1160
White shale	250	1410
Limestone and sandstone	180	1590
Brown shale	115	1705
Limestone	250	1955

Sulphur water at 1905 feet, but no show of oil or gas reported.

WABASH COUNTY

The bed rock strata in this county belong to the Silurian period. The drift overlying varies from 25 to 300 feet and conceals the bed rock strata to such an extent that stratigraphical and structural conditions are difficult to determine. The surface of the Trenton lies from 100 to 400 feet below sea level. The total thickness of the Niagara in this county is probably about 450 feet. The following are records of wells drilled at Wabash:[2]

Drift	36	feet.
Bluish limestone	54	"
White limestone	20	"
Bluish limestone varying to green	140	"
Whitish limestone	30	"
Bluish limestone	60	"
Bluish green Niagara shale	35	"
Bluish gray limestone (Clinton)	20	"
Hudson River limestones and shales	205	"
Utica shale	280	"
Trenton limestone (salt water)	7	"
Total depth	887	feet.
Altitude of well	680	"

Section of Well No. 2.

Drift	28	feet.
Niagara limestone and shale	525	"
Hudson River and Utica	325	"
Trenton limestone	54	"
Total depth	932	feet.
Trenton below sea level	198	"

Did not yield gas nor oil.

Record of a well drilled at North Manchester:[2]

The following is the log of a well drilled in S. W. ¼ of Section 34, Liberty township. Drilled in 1903:

Drive pipe	202	feet.
Casing	470	"
Top of Trenton	945	"
Total depth	965	"

A log of a well drilled at LaFountaine is given below:

Section of Well No. 1.

Drift	300	feet.
Niagara limestone	225	"
Hudson River limestone and shale	175	"
Utica shale	200	"
Trenton limestone	23	"
Total depth	923	feet.
Trenton below sea level	6	"

Yielded strong flow of gas.

Section of Well No. 1.

Drift	274	feet.
Niagara limestone and shales	300	"
Hudson River limestone and shales	250	"
Utica shale	306	"
Trenton limestone	50	"
Total depth	1180	"
Trenton below sea level	365	"

Yielded no gas.

WARREN COUNTY

The bed rock formations which have been recognized by direct observation belong to the Knobstone, Harrodsburg (Warsaw), Salem, Mitchell and Chester Divisions of the Mississippian and the Mansfield (Pottsville) and coal measures (Allegheny) divisions of the Pennsylvanian. Overlying these formations are Pleistocene and Recent deposits of sand clay and gravel. The mantle rock or drift attains a thickness of more than two hundred feet. The Pennsylvanian rocks attain a thickness of about 225 feet, the Mississippian of about 110 feet; and the Devonian of about 525 feet. Devonian and Trenton strata which may be productive of oil and gas, if the proper geological structures exist, lie below the formations mentioned above. The surface of the Trenton lies probably from 1500 to 1800 feet below the surface of the county. The outcrops of the bed rock are not sufficiently numerous to make it possible to determine the structural conditions under which the formations exist. By the aid of well records, coal-shaft records and outcrops, it may be possible to determine the structural conditions favorable to the accumulation of oil and gas.

A deep well was drilled at Williamsport which struck salt water at 1200 feet. It is not probable that this well reached the Trenton limestone, it more probably reached the upper part of the Silurian.

Railroad Elevations.

Pine Village 702; Chatterton 714; Winthrop 677; Kickapoo 546; Independence 521; State Line 694 (C. & E. I.) Pence 700; Finney 719; Judyville 771.

WARRICK COUNTY

This is another one of the counties lying wholly within the unglaciated area of the state and the outcrops of the strata, where concealed, are only by alluvium and residual deposits of glacial and post-glacial age. The rocks of the Pennsylvanian period outcrop in the county. The structural conditions of the county are difficult to study because of the absence of outcrops of persistent layers in sufficient numbers. In the region of coal mines, some of the coal beds may be used as key formations in determining the structures. The Petersburg Coal, for instance, is an important and persistent bed of coal from the line of its outcrop to the western line of the county and might be used if a sufficient number of shafts or drill holes reached it. Structural lines were drawn on the surface of this coal for a part of this county and published in the Ditney Folio.

Not many well records are available for this county. The following have been reported:

Ohio Township. A well was drilled to a depth of 1450 feet in section 15 but no production was obtained.

Lane Township. A well was drilled in section 29 on the Elisha Burr property and plugged in 1911.

Record of dry hole on the John N. Miller lease, S. E. ¼ of the N. W. ¼ of Section 19, Boone Township:

Surface, loam and shale	to 40	feet.
Shale	60	"
Lime and shale	85	"
Shale	105	"
Fire clay	120	"
Black shale (cave)	130	"
Black shale	143	"
Coal	149	"
Hard shale	152	"
White shale	202	"
Black shale	222	"
Fire clay and shale	322	"
Shale and shells	333	"
Limestone	336	"
Coal	341½	"
Shale and shells	390	"
Limestone and shells	416	"
Brown shale	465	"
White shale	567	"
Brown shale	617	"

Shale and shells	717	feet.
Black shale	767	"
Lime shells	787	"
Gray shale	827	"
Black shale	837	"
White sand (full of salt water)	907	"
White shale	947	"
Brown shale	1047	"
Shale	1265	"
Brown lime	1280	"
Black shale	1292	"
Red cave	1300	"
Soft black shale	1323	"
Salt sand, yielding salt water	1383	"

The second dry hole in Warrick County was on the Barkley lease in the S. E. ¼ of the N. E. ¼ of Section 21, Hart Township. Its record showed a total depth of 1310 feet. A very slight showing of oil occurred at 1220 feet.

WASHINGTON COUNTY

Washington County lies largely within the unglaciated area of the State, only a small area in the northwestern part of the county is covered with glacial drift. The rocks which appear at the surface of this county belong to the Quaternary and the Mississippian periods. The sub-divisions are given in the table below:

Quaternary	Recent—Sands, clays and alluvium. Pleistocene—Sands and gravels.
Mississippian	Mitchell limestone. Salem limestone. Harrodsburg limestone. Knobstone, shales and sandstones.

A large part of the surface of the county is included in the Mitchell plain on which there are few outcrops that can be used in determining structures favorable for the accumulation of oil. The best key formation is the contact between the Knobstone and the Harrodsburg (Warsaw). Some gas was obtained at Salem from the Devonian limestone but the structural conditions existing there have not been determined. The following is the record of a well drilled at that point:

Section of Well No. 1.

Soil	7	feet.
Keokuk limestone	53	"
Sub-carboniferous sandstone	567	"
Hamilton shale	103	"
Devonian limestone	40	"
Niagara limestone	215	"
Clinton (?) limestone	30	"

Hudson River limestone and shale	535	"
Utica shale	180	"
Trenton limestone	45	"
Total depth	1775	feet.
Trenton below sea level	1000	"

Yielded good flow of gas. The gas was found in the limestone underlying the Devonian shale.

WAYNE COUNTY

Rocks of Ordovician and Silurian age occupy the subsurface of this county, but are exposed at few places being covered with glacial drift which attains a thickness of more than two hundred feet.

Wayne Township. At Richmond a well was drilled the log of which was recorded as follows by Gorby:[2]

Hudson River limestone and shale	500	feet.
Utica shale	380	"
Trenton limestone	510	"
St. Petér's sandstone	10	"
Total depth	1400	"
Trenton above sea level	79	"

Another well reached the Trenton at 945 feet, another at 886 feet, and another at 972 feet.

Jefferson Township: At Hagertown gás was found in a number of wells. One of the wells passed through 100 feet of drift, reached the Trenton at 846 feet, 167 feet above sea level.

Jackson Township: Two wells drilled at Cambridge City gave the following sections:

Drift	96	feet.
Niagara limestone	2	"
Hudson River and Utica	668	"
Trenton limestone	134	"
Total depth	900	feet.
Trenton above sea level	174	"

No. 2 passed through 100 feet of drift and reached the Trenton at 847 feet.

The records of other wells drilled in the county as given by Phinney are as follows:

	Dublin	Dalton	Washington	Russell	Fountain
Drift	300	275	212	......	185
Depth of Trenton	868	960	976	909	1025
Altitude of surface	1066	......	1100	1029	1011
Altitude of Trenton	198	......	124	120	86

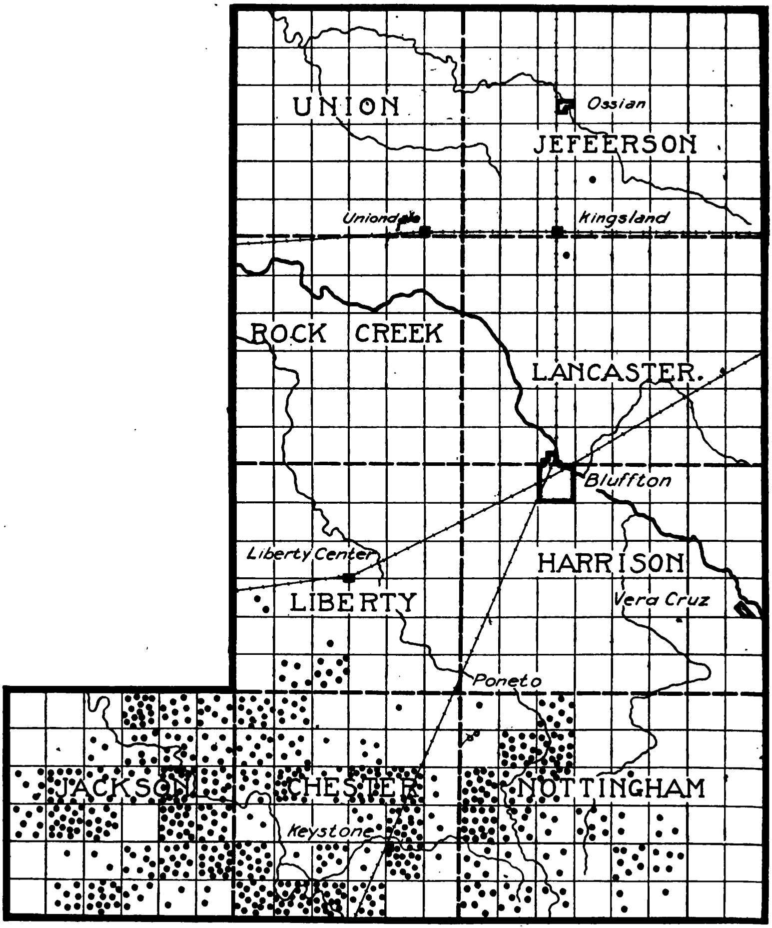

Fig. 62. Map of Wells County showing location of recorded abandoned wells. The southern tier of townships is oil territory. Some extension has been made recently in Liberty Township.

WELLS COUNTY

This county lies within the area occupied by the Silurian strata which is covered with glacial drift. The stratagraphical and the structural conditions can be determined by the study of well records. This county has produced oil and the old field has recently been extended in the western part of the county. The records of some of the wells are given below:

Chester Township. A large number of wells were drilled in this township. Two wells drilled in 1908, started at 80 and 85 barrels each. The abandoned wells are: Section 2, 1 well; Section 5, 6 wells; Section 6,

5 wells; Section 7, 9 wells; Section 8, 19 wells; Section 9, 1 well; Section 10, 4 wells; Section 14, 13 wells; Section 15, 37 wells; Section 16, 3 wells; Section 17, 18 wells; Section 18, 7 wells; Section 22, 4 wells; Section 23, 19 wells; Section 27, 1 well; Section 30, 21 wells; Section 31, 8 wells; Section 32, 16 wells; Section 33, 2 wells; Section 34, 11 wells.

Jackson Township. A well was drilled in 1908 in Section 12, S. E. ¼, and yielded 110 barrels the first day. The following is the average record of the wells in the N. W. ¼ of Section 20:

Drive pipe	153 feet.
Casing	385 "
Top of Trenton	989 "
Total depth	1045 "

A bore on the Palmer lease, east half of the N. W. ¼ of Section 31 had the following record:

Drive pipe	130 feet.
Casing	340 "
Top of Trenton	985 "
Total depth	1045 "

The abandoned wells are as follows: Section 1, 9 wells; Section 2, 8 wells; Section 3, 9 wells; Section 9, 3 wells; Section 10, 8 wells; Section 11, 8 wells; Section 12, 9 wells; Section 13, 16 wells; Section 14, 26 wells; Section 15, 8 wells; Section 16, 13 wells; Section 17, 11 wells; Section 18, 5 wells; Section 19, 10 wells; Section 21, 27 wells; Section 22, 1 well; Section 23, 28 wells; Section 24, 15 wells; Section 25, 40 wells; Section 26, 12 wells; Section 27, 8 wells; Section 28, 3 wells; Section 29, 1 well; Section 32, 7 wells; Section 33, 14 wells; Section 34, 7 wells; Section 35, 2 wells; Section 36, 7 wells.

Nottingham Township. A well drilled on the Dickinson tract, in the N. E. ¼ of Section 28 has the following record:

Drive pipe	38 feet.
Casing	332 "
Top of Trenton	1005 "
Total depth	1050 "
Initial output	30 bbls.

Abandoned wells are as follows: Section 4, 9 wells; Section 6, 1 well; Section 9, 15 wells; Section 8, 15 wells; Section 14, 1 well; Section 16, 8 wells; Section 17, 6 wells; Section 18, 21 wells; Section 19, 29 wells; Section 20, 7 wells; Section 21, 3 wells; Section 22, 7 wells; Section 23, 2 wells; Section 24, 2 wells; Section 25, 3 wells; Section 26, 8 wells; Section 28, 3 wells; Section 29, 1 well; Section 30, 5 wells; Section 31, 7 wells; Section 32, 6 wells; Section 33, 3 wells; Section 35, 2 wells; Section 36, 1 well.

Harrison Township. Section of well No. 1, Bluffton, Indiana:

Drift	12	feet.
Niagara limestone and shale	413	"
Hudson River limestone and shale	340	"
Utica shale	285	"
Trenton limestone	150	"
Total depth	1200	"
Trenton below sea level	213	"

Yielded no gas.

Section of well No. 2, Bluffton, Indiana:

Drift	51	feet.
Water lime	30	"
Niagara limestone	479	"
Hudson River limestone and shale	340	"
Utica shale	175	"
Trenton limestone	31	"
Total depth	1106	"
Trenton below sea level	238	"

Liberty Township. A large number of wells were drilled in this township. The following have been abandoned: Section 19, 2 wells; Section 28, 1 well; Section 32, 5 wells; Section 33, 8 wells.

Lancaster Township. A well was abandoned in Section 4 on the property of H. Rupright in 1919.

Jefferson Township. A well drilled on the property of Grover Gibson in Section 27 was abandoned in 1919.

WHITE COUNTY

Strata of the Mississippian age occupy the subsurface of the southwestern portion of this county; Devonian strata, the central portion; and Silurian strata the eastern portion. A mantle of glacial drift largely conceals these strata and attains a thickness of from 200 to 300 feet. The structural condition of the strata of the durolith cannot be determined by direct observation because of the overlying drift.

The record of a well drilled at Monticello is given below:

Section of Well No. 1

Drift	205	feet.
Niagara limestone	515	"
Hudson River limestone and shale	120	"
Utica shale	170	"
Trenton limestone	63	"
Total depth	1073	"
Trenton below sea level	338	"

Yielded no gas.

A well drilled at Monon is reported as follows:

Limestone	530	feet.
Shale	30	"
Petroliferous limestone (Clinton?)	25	"
Shale	285	"
Trenton limestone	50	"
Total depth	920	"
Altitude of well	664	"

The surface of the Trenton lies from 250 to 400 feet below sea level in this county.

Railroad Elevations

Burnettsville 711.2; Idaville 709.7; Monticello 677.9; Reynolds 691.2; Seafield 697.7; Walcott 714.1; Lee 671; Monon 672.3; Wheelers 690.7; Chalmers 708.9.

WHITLEY COUNTY

The strata which form the bed rock for this county belong to the Silurian and the Devonian periods. The strata dip northward. They are concealed by an overburden of glacial drift which attains a thickness of more than three hundred feet. At Columbia City a deep well was drilled and salt water was encountered at 900 and at 1,375 feet. A bed of salt 25 feet thick was reported at a depth of 872 feet. The record of the well follows:

Drift	224	feet.
Limestone	350	"
Shale	776	"
Trenton limestone	25	"
Total depth	1375	"
Altitude of well	816	"

Gorby gave the following log of a well at Columbia City:

Section of Well No. 1

Drift	224	feet.
Niagara limestone and shale	526	"
Hudson River limestone and shale	400	"
Utica shale	218	"
Trenton limestone	39	"
Total depth	1407	"
Trenton below sea level	545	"

Yielded no gas.

Another well drilled at Larwill, northwest of Columbia City, has the following log:

Drift	365	feet.
Blue limestone	300	"
Whitish limestone	200	"
Bluish limestone	22	"
Niagara shale	43	"
Clinton limestone (salt water)	14	"
Shale	43	"
Limestone, salt water	43	"
Bluish green shale	212	"
Black shale	300	"
Trenton limestone	51	"
Total depth	1593	"
Altitude of well	950	"

The structural conditions of the durolith are not determinable by the direct observations on account of the glacial covering. Subsurface work will depend upon data secured from deep wells.

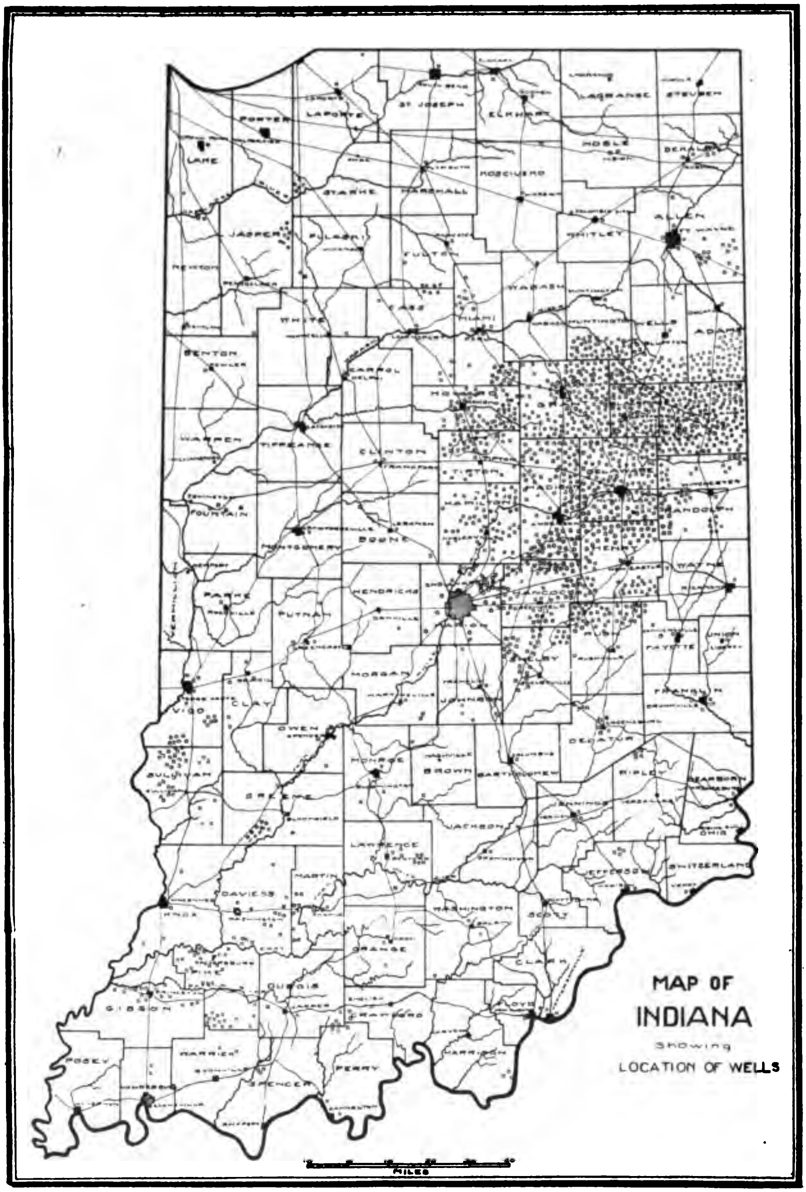

Fig. 63. Map showing distribution of oil, gas and dry wells drilled in Indiana. Space does not permit the location of all wells drilled in the oil and gas producing areas.

INDEX